INTERNATIONAL FEDERATION FOR INFORMATION PROCESSING
WG 9.4: SOCIAL IMPLICATIONS OF COMPUTERS IN DEVELOPING COUNTRIES

IFIP WG9.4
Abuja, Nigeria
May 26 - 28, 2005

2005 Conference

Enhancing Human Resource Development through ICT

Nicon Hilton Hotel
Abuja, Nigeria
26-28 May 2005

PROCEEDINGS OF THE EIGHT INTERNATIONAL WORKING CONFERENCE OF IFIP WG 9.4

Presented by
International Federation for Information Processing (IFIP) Technical Committee (TC) 9 – Computers & Society Working Group 9.4 – Social Implications of Computers in Developing Countries

In association with
The National Information Technology Development Agency (NITDA), the Computer Professionals Registration Council of Nigeria (CPN) and the Nigerian Computer Society (NCS)

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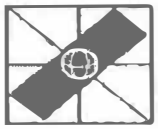

IFIP WG9.4
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AUA2005

IFIP
INTERNATIONAL FEDERATION FOR INFORMATION PROCESSING

PROCEEDINGS

OF THE EIGHT

International Working Conference of IFIP WG 9.4

Enhancing Human Resource Development through ICT

May 26 – 28, 2005
at the
NICON HILTON, ABUJA-NIGERIA

Editors: **Dr. Abiodun O. Bada**
The George Washington University, USA
Dr. Adekunle Okunoye
Xavier University, USA

Proceeedings of the Eight
International Working Conference of IFIP WG 9.4

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Enhancing Human Resource Development through ICT

Message from the Chair

At the time of going to press, all indications are that the 2005 IFIP WG 9.4 International Conference in Abuja, Nigeria, will be more than a mild success. At this year's conference we are discussing the issue of enhancing human resource development through Information and Communication Technologies (ICT). The importance of ICT in enabling social, economic and political growth in developing countries (DCs) is widely acknowledged in contemporary times. In addition, the importance of investing in human resources as a critical component of any development initiative is also widely acknowledged. Changes in ICT and their applications have brought new demands about the knowledge and skills required to function effectively in the changing technological and business environment. Knowledge and skills that are relevant to local issues are seen as fundamental in preparing DCs for a greater role within the information society. Therefore, as developing countries strive to achieve a balance between global competitiveness and relevant context-sensitive development initiatives, I believe this is an opportune moment to examine new ways in which ICT can be effectively deployed in the process of developing human resources that will contribute to economic, social and political progress in DCs.

I want to take this opportunity to thank everyone for the part they played in the organization of this conference. From the authors to the Program Committee members who reviewed manuscripts - especially those I kept calling on to review additional papers and they never turned me down. As Chair, I would like to use this opportunity to also outline some of our most immediate challenges as a group. Our first challenge has to do with finances. Our desire is to see more colleagues based in DCs attend our conferences to share their intellectual contributions. That means we need a healthy enough financial base to be able to pick up a significant portion of their expenses. We are not there yet. In fact, this year has been a huge struggle without the support of the Commonwealth Secretariat, which over the years has been our major source of funding. We are grateful for IFIP and Prof. Dipak Khakhar (IFIP Treasurer), Dr. G.A.T Oboh of Union Bank of Nigeria Plc, Prof. Tom Mazzuchi of EMSE Dept at GWU and SystemSpecs for stepping up and giving us some financial support. This has enabled us to give assistance to some participants but we still lost a few papers because we were unable to provide for everyone that needed support. Perhaps, we can discuss this more during the business meeting and we welcome any suggestions. Our second major challenge deals with adherence to Manuscript Submission Guidelines—specifically the lack thereof. It will help our cause, in future, if all authors—not just some—adhere very strictly to submission guidelines. Our third and final major challenge deals with the question of how we can increase participation of IT practitioners in our conferences. I've raised these concerns in my opening remarks so that we can start thinking about them early enough before the business meeting.

A lot of people, institutions and organizations have been instrumental in making this conference a success, and it is to these that I reserve my concluding remarks. The LOC members and especially the energetic chair – Mr. Manny Emecheta - have our lasting gratitude for their support in organizing this conference. I also want to thank our Keynote Speakers: the Host Minister, Mallam Nasir el-Rufai (Chairman, FCDA); Prof. Turner Isoun, the Hon. Minister of Science and Technology under whose direction the IT field in Nigeria is ably placed, Dr. G.A.T. Oboh, CEO of Union Bank (Nig) Plc and Prof. Subhash Bhatnagar of IIMA and the World Bank.

From all of us at IFIP WG 9.4, thank you

Abiodun O. Bada, PhD
IFIP WG 9.4 Chair & 2005 Conference Chair
Asst. Professor (Software Engineering & Information Systems Management)
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2005 PROGRAM

OVERVIEW

O Wednesday, May 25, 2005

4:00 PM—5:00PM	Registration
6:00PM—8:00PM	Welcoming Cocktail

A Thursday, May 26, 2005

8:30 AM—9:10 AM	Registration
9:10AM—11:00AM	**PLENARY SESSION** **ENHANCING HUMAN RESOURCE DEVELOPMENT THROUGH ICT**
9:10AM—11:00AM	Welcome Remarks: *IFIP WG 9.4 Chair & 2005 Conference Chair* **Official Opening:** **Ag.** *Director-General, NITDA* **Opening Keynote:** *Chairman, FCDA – Mallam Nasir El-Rufai*
11:30AM—01:00PM	Plenary Session
02:00PM—03:40PM	Concurrent Sessions
04:00PM – 05:40PM	Concurrent Sessions
06:30PM	Nigerian B-B-Q Night: **Welcoming Dinner** sponsored by Union bank (Nig) Plc Keynote Speaker: ***Prof. Turner Isoun – Hon. Minister of Science & Tech*** Venue: **Fulani Pool Restaurant & Bar, Nicon Hilton**

B Friday, May 27, 2005

8:30AM—9:30AM	Registration
9:30AM—11:00AM	Plenary Session – Keynote Speech: Prof. Subhash Bhatnagar
11:30AM—01:10PM	Concurrent Sessions
02:00PM—03:40PM	Concurrent Sessions
04:00PM—05:40PM	Concurrent Sessions
06:30PM	**Cultural Event & Conference Dinner,** Keynote Speaker: ***Dr. G.A.T. Oboh, CEO Union Bank (Nig) Plc*** Topic: IT and HR Development in Union Bank: Challenges and Prospects Venue: **Bukka Restaurant, Nicon Hilton**

C Saturday, May 28, 2005

09:00AM—10:00AM	Plenary Session - IFIP WG 9.4 Business Meeting/Announcing Host for 2007 Conference
10:30AM—12:10AM	Concurrent Sessions
12:00—01:30PM	Concurrent Sessions
1:00PM – 5:00PM	Delegates undertake Tour of Abuja

THURSDAY - MAY 26, 2005

8:30AM—09:10AM	**REGISTRATION** Venue: (OGUN/NASSARAWA LOBBY)	
9:10AM—11:00AM	**PLENARY SESSION** Venue: (OGUN/NASSARAWA)	

THEME: ENHANCING HUMAN RESOURCE DEVELOPMENT THROUGH ICT

9:10AM—9:30AM	Welcome Remarks:	***IFIP WG 9.4 Chair &*** 2005 Conference Chair
9:30AM—10:15AM	**Official Opening:**	**Ag. Director-General, NITDA**
10:15AM—11:00AM	Opening Keynote:	Chairman, FCDA – Mallam Nasir El-Rufai
11:00AM—11:30AM	Tea/Coffee Break	
11:30AM—05:40PM	Plenary & Concurrent Sessions	Begin on the next page

Plenary Session 11:30AM – 01:00PM

SESSION A1: 11:30AM – 01:00PM..... .....Location: OGUN/NASSARAWA
TITLE: **Research Papers: Theoretical Perspectives**
Chair: Mikko Korpela, University of Kuopio, Finland

1. From Digital Divides to Digital Societies? (***Chris Westrup*** University of Manchester, UK & ***Saheer Al-Jaghoub***, Al-Ahliyya Amman University, Jordan)
2. Reconsidering ICT for Development Research: Critical Realism, Empowerment, and the Limitations of Current Research (***Matthew L. Smith***, London School of Economics and Political Science)
3. Scaling Of Health Information Systems In India: Challenges And Approaches (***Sundeep Sahay***, University of Oslo, Norway & ***Geoff Walsham,*** Cambridge University, UK)
4. Offshore IT outsourcing to emerging economies – analysis of readiness vs. attractivess (***Olayele Adelakun***, DePaul Univeristy, Illinois, USA)

LUNCH BREAK 01:00PM – 02:00PM

Concurrent Sessions 02:00PM – 03:40PM

SESSION A2: 02:00PM – 03:40PM ....Location: OGUN
TITLE: **Research Papers: Theoretical Perspectives**
Chair: ***Shirin Madon,*** *London School of Economics, UK*

1. Implementation of Free and Open Source Software within a developing country context: The Cuban Case (***Amit Mitra*** & ***Alexeis Garcia***, University of Salford, UK)
2. Towards E-Government in Nigeria: Shortcomings, Successes, Swish Or Sink (***Princely Ifinedo***, University of Jyväskylä, Finland & ***Charles Uwadia***, University of Lagos, Nigeria)
3. The role of IT in supporting women entrepreneurs in urban Tanzania (***Hawa Petro Tundui***, Mzumbe University, Tanzania & ***Bjørn Erik Munkvold***, Agder University College, Norway)
4. Generalisations From An Interpretive Study: The Case Of A South African Community-Based Health Information System (***Elaine Byrne***, University of the Western Cape, South Africa and ***Sundeep Sahay***, University of Oslo, Norway)

SESSION A3: 02:00PM – 03:40PM ....Location: NASSARAWA
TITLE: **Research Papers: Theoretical Perspectives**
Co-Chairs: **Judith Gregory,** *University of Oslo, Norway*

1. Challenges of User Participation in the Design of a Computer Based System: The Possibility of Participatory Customisation in Low Income Countries (***Honest C. Kimaro*** & ***Ola Hodne Titlestad***, University of Oslo, Norway).
2. Reflecting on National Spatial Data Infrastructure Implementation in India: The Need For Socio-Technical Approaches (***Yola Georgiadou, Satish K. Puri,*** International Institute for Geo-Information Science and Earth Observation (ITC), The Netherlands & ***Sundeep Sahay***, University of Oslo, Norway)
3. Justifying the Modification of Technology Acceptance Model to Match Realities in Developing Countries (***Philip F. Musa,*** The University of Alabama at Birmingham, USA, ***Peter Meso***, Georgia State University, USA; ***Victor W. Mbarika***, Southern University and A&M College, USA)
4. Paradigms of ICT in Development (***Maung K. Sein***, Agder University College, Norway)

03:40 PM—04:00 PM TEA/COFFEE BREAK

Concurrent Sessions 04:00 PM– 05:40PM

SESSION A4 04:00 PM– 05:40PM ....Location: OGUN
TITLE: **Research Papers: IT & HR Development in Education and Learning**
Chair: **Geoff Walsham,** Cambridge University, UK

1. Systems for the Production of Plagiarists: Developing countries and use of plagiarism detection systems in UK universities (***Niall Hayes & Lucas Introna***, Lancaster University, UK)
2. Rural Community and Human Development Through Information Technology Education: Empirical Evidence from Western Nigeria (***Adekunle Okunoye***, ***Nancy Bertaux,*** Xavier University, USA; ***Muraina Oyelami***, Obatala Center for Creative Art, Nigeria)
3. Institutions and ICTs in Makerere University: Bridging Digital Divide or Spreading Donor Dependence? (***Alemayehu Molla***, The University of Manchester, UK; ***Matia K. Kabuye***, Makerere University, Uganda; ***Savita Bailur***, The University of Manchester, UK)
4. Re-inventing Higher Learning Institutions Communication Media: The case of University of Dar es Salaam Student Information System (***Juma H. Lungo***, University of Dar es Salaam, Tanzania)

SESSION A5 04:00 PM– 05:40PM .....Location: NASSARAWA
TITLE: **Research-in-Progress**
Chair: **Sundeep Sahay,** University of Oslo, Norway

1. ICTs and Capacity Building through Apprenticeship and Participatory Methods Applied to an ICT-based Agricultural Water Management System (***Alexander Osterwalder***, University of Lausanne, Switzerland; ***Jacques Panchard,*** Ecole Polytechnique Fédérale de Lausanne, Switzerland)
2. Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway (***Petter Nielsen***, University of Oslo, Norway***; José Leopoldo Nhampossa***, University of Oslo, Norway)
3. Gender Differences in Mobile ICT Use: An Empirical Investigation in Two Developing Countries (***Peter Meso***, Georgia State University, USA; ***Victor Mbarika***, Southern University and A&M College, USA; ***Philip Musa***, University of Alabama at Birmingham, USA)
4. Internet Cafés – Venues for Learning in Developing Countries (***Bjørn Furuholt***, Agder University College, Norway; ***Stein Kristiansen***, Agder University College, Norway)

06:30PM **Nigerian B-B-Q Night**: Welcome Dinner
Keynote Speaker: ***Prof. Turner Isoun – Hon. Minister of Science & Technology***
Venue: **Fulani Pool Restaurant & Bar, Nicon Hilton**



FRIDAY, MAY 27, 2005

8:30AM—09:30AM **REGISTRATION**
Venue: (OGUN/NASSARAWA LOBBY)

9:30AM—11:00AM **PLENARY SESSION**
Venue: (OGUN/NASSARAWA)

10:15AM—11:00AM Keynote Speech: **Prof. Subhash Bhatnagar,** Indian Institute of Management, Ahmedabad (IIMA) & The World Bank, DC
Topic: **Building a Knowledge Society: Challenges in bridging the digital divide**

11:00AM—11:30AM Tea/Coffee Break

Concurrent Sessions 11:30AM – 01:10 PM

SESSION B1 11:30AM – 01:10 PM ....Location: OGUN
TITLE: **Research Papers: IT & HR Development in the Public Sector**
Chair: ***Peter Meso***, Georgia State University, USA

1. Challenges and Opportunities of Implementing District-based Health Information System in Ethiopia: A case study from Benishangul-Gumuz Region (***Shegaw Anagaw Mengiste***, University of Oslo, Norway)
2. Enhancing Managerial Quality in Government ICT Projects: Lessons from Gujarat (***Shirin Madon***, London School of Economics, UK)
3. Understanding the interplay between actors involved in the development of an organisation for telecentre network management: The E-citizenship project of the City of São Paulo (Brazil) (***Marie Anne Macadar & Nicolau Reinhard,*** University of São Paulo, São Paulo-SP-Brazil)
4. Expert assessments of Cultural effects on e-Business in developing countries (***Chitu Okoli***, Concordia University, Canada; ***Victor W. A. Mbarika***, Southern University and A&M College, USA & ***Scott McCoy***, College of William and Mary, USA)

SESSION B2 11:30AM – 01:10 PM .....Location: NASSARAWA
TITLE: **Research-in-Progress**
Chair*: **Olayele Adelakun,*** DePaul University, USA

1. Discussion of the Representation of Relationships under the Aspect of Hierarchic Structure and Power in a Computer Project in South-western Uganda (***Raphael Schneeberger & Gerald Steinhardt***, Vienna University of Technology, Austria)
2. Small Island Developing States as Emerging Software Exporting Nations: The Case of Mauritius (***Savita Bailur***, University of Manchester, UK; ***Baljinder Sharma***, University of Mauritius, Mauritius)
3. Push-Pull Factors in Routine Health Management Information Systems: Towards a Conceptual Framework to Evaluate, Plan and Improve the Capacity and Influence of RHMIS Actors in Developing Countries (***Marius Gouws***, University of the Western Cape, South Africa; ***Judith Gregory***, University of Oslo, Norway)
4. Implications of (non)Participation of Users in Implementation of the Health Information System Project (HISP) in Andhra Pradesh: Practical Experiences (***Zubeeda Quraishy & Judith Gregory*** University of Oslo, Norway)

LUNCH BREAK 01:10PM – 02:00PM

Concurrent Sessions 02:00 PM – 03:40PM

SESSION B3 02:00 PM – 03:40PM..... .....Location: OGUN
TITLE: **Research Papers: Theoretical Perspectives**
Chair: ***Victor Mbarika***, Southern University and A&M College, USA

1. Social Construction of Software Customization: the Case of Health information Systems from Mozambique and India (***José Leopoldo Nhampossa*** & ***Sundeep Sahay***, University of Oslo, Norway)
2. Contextual issues impacting the appropriateness of ICT: Setting the stage for socio-technical research in Africa (***Anja Mursu, Tuija Tiihonen, & Mikko Korpela,*** University of Kuopio, Finland)
3. Using ICT to Develop Botswana: An Analysis of Government Proposals and Recommendations for Action (***Dipak Khakhar***, University of Lund, Sweden; ***Dewald Roode***, University of Cape Town, South Africa)
4. Maximising the Benefits of B2B E-Commerce by SMEs in Developing Countries: The Cluster Model Alternative (***Dili Ojukwu*** & ***Elli Georgiadou***, Middlesex University, UK)

SESSION B4 02:00 PM – 03:40PM.....Location: NASSARAWA
TITLE: **Research Papers: IT & HR Development in Education and Learning**
Chair: Godwin Udo, Univeristy of Texas at El Paso, USA

1. The Relevance of Local Dialects to ICT Advancement in Developing Countries: Yoruba Language as Case study (***Ajayi A.O, Adagunodo, E.R. and Aderounmu, G.A.,*** Obafemi Awolowo University, Ile-Ife, Nigeria)
2. Nigerian University Software Development Training: From Building Walls to Building Bridges (***Soriyan H.A, Oluwaranti A. I, Afolabi A.O., Ikono R.N,*** Obafemi Awolowo University, Nigeria; ***Anja Mursu & Mikko Korpela,*** University of Kuopio, Finland)
3. Gandhi's Third Assassination: ICT Education in India (***Jonathan Ezer,*** London School of Economics, UK)
4. Application of Information and Communication Technologies (ICT) in the Control of Scientific Literature in Africa: Status, Deficits and Human Resource Development Implications (***Williams Nwagwu,*** ARCIS, University of Ibadan, Nigeria)

3:40 PM—04:00PM TEA/COFFEE BREAK

Concurrent Sessions 04:00PM-05:40PM

SESSION B5: 04:00PM-05:40PM **.....Location: NASSARAWA**
TITLE: **Research Papers: Theoretical Perspectives**
Chair: ***Trish Alexander,*** University of Pretoria, South Africa

1. A Research Agenda For Research Projects in the Private Healthcare Sector of South Africa (***Retha de la Harpe***, Cape Peninsula University of Technology, South Africa)
2. Standardization of Health Information Systems in South Africa: The Challenge of Local Sustainability (***Edoardo Jacucci***, Univ. of Oslo, Norway; ***Vincent Shaw & Jørn Braa*** Univ. of Western Cape, SA)
3. IT Perspectives: The Case of Women in Sub-Saharan Africa (***Victor W. A. Mbarika***, Southern University and A&M, USA; ***Fay Cobb Payton***, North Carolina State University, USA; ***Lynette Kvasny***, Penn State University, USA; ***Atieno Amadi***, Jomo Kenyatta University of Arts and Technology, Kenya)
4. Extranet Technology and Inter-Organisational Knowledge Sharing: Understanding the Influence of Mexican Cultural Values (***Juan Pablo Duran & Niall Hayes,*** Lancaster University, UK)

SESSION B6: 04:00PM-05:40PM **.....Location: OGUN**
TITLE: **Research Papers: IT & HR Development in Education and Learning**
Chair: ***Maung K. Sein***, Agder University College, Norway

1. Information Technology in a Developing Country: the Nigerian University Experience (***Bimbo Idowu, Rotimi Adagunodo & Bayo Idowu,*** Obafemi Awolowo University, Nigeria)
2. Research on ICTs in sub-Saharan Africa: need for a mitigated euphoria ***(Victor W. A. Mbarika,*** Southern Univ. and A&M College, USA; ***Philip Musa***, Univ. of Alabama-Birmingham, USA; ***Peter Meso,*** Goergia State University, USA; ***Chitu Okoli,*** Concordia Univ., Canada; ***Terry Anthony Byrd,*** Auburn Univ. USA)
3. Risk Identification and Management in Information Systems Development Projects within the Nigerian University Environments: An Empirical Study (***Princely Ifinedo***, University of Jyväskylä, Finland; ***Charles Uwadia***, University of Lagos, Nigeria; ***Goodluck Nwamarah***, University of Nigeria, Nsukka)
4. Training and Capacity Building to Sustain Health Care Information Systems at a Local Level in India (***Usha Srinath & Jørn Braa***, University of Oslo, Norway)

06:30PM **Cultural Event & Conference Dinner**
Keynote Speaker: ***Dr. G.A.T. Uboh***, Chief Executive Officer, Union Bank (Nig) Plc
Topic: IT and HR Development in Union Bank: Challenges and Prospects
Venue: **Bukka Restaurant, Nicon Hilton**

SATURDAY, MAY 28, 2005

09:00AM—10:00AM **IFIP WG 9.4 BUSINESS MEETING**
IFIP WG 9.4 2007 Conference: Announcing and Presenting Hosts
Venue: (OGUN/NASSARAWA)

10:00AM —10:30AM TEA/COFFEE BREAK

Concurrent Sessions 10:30AM - 12:10 AM

SESSION C1: 10:30AM - 12:10AM .....Location: NASSARAWA
TITLE: **Research Papers: IT & HR Development in the Public Sector**
Chair: ***Anja Mursu,*** University of Kuopio, Finland

1. Importance of Human Resource Capacity in the Context of Low Income Countries (***Honest C. Kimaro***, University of Oslo, Norway)
2. The Potential of District Health Information Software in Tanzania (***Juma H. Lungo***, University of Dar es Salaam, Tanzania)
3. National Human Resource Development Policy For Software Exports: Case Evidence From Costa Rica (***Brian Nicholson,*** University of Manchester, UK & ***Sundeep Sahay***, University of Oslo, Norway)
4. Collaboration: Unearthing Business Opportunities for a Rural Community in South Africa ***(PM Alexander, H Lotriet, J Phahlamohlaka, JJ van Loggerenberg,*** University of Pretoria, South Africa)

SESSION C2: 10:30AM - 12:10AM .....Location: OGUN
TITLE: **Research-in-Progress**
Chair: ***Kunle Okunoye,*** Xavier University, USA

1. Expert assessments of e-Business in developing countries: A theoretical model of National infrastructure (***Chitu Okoli,*** Concordia University, Canada & ***Victor W. A. Mbarika,*** Southern University and A&M College, USA)
2. Development of a Computer-Based PHC Management System: Towards a Holistic System (***Soriyan H.A, Afolabi A.O. , Fatusi, Adesegun, Akinde A.D***. Obafemi Awolowo University, Nigeria; ***Korpela M.***, University of Kuopio, Finland)
3. The Evolution of a Framework for Assessing Hospital Information Systems in South Africa (***Vincent Shaw***, University of Western Cape, South Africa; ***Edoardo Jacucci & Jørn Braa***, University of Oslo, Norway)
4. Towards Knowledge Engineering for Expertise Retention in Developing Countries (***B. O. Akinkunmi' A. O. Osofisan' Idongesit F. Essien & Adebusola O. Ladipo,*** Dept of Computer Science, University of Ibadan, Ibadan, Nigeria)

LUNCH BREAK 12:10PM – 01:00PM

Conference Ends: End of official conference program

1PM – 5PM Saturday, May 28, 2005: Delegates undertake Tour of Abuja

We look forward to seeing you all at the 2007 IFIP WG 9.4 Conference

Bon Voyage

PREFACE

The 8th IFIP WG 9.4 international working conference provides a forum to explore issues concerned with building a skilled and adaptable workforce in developing countries (DCs) for the information age. Institutional response to the changing environment of ICT in DCs has been largely slow and ineffective. Skills shortages and gaps, lack of a coherent policy towards developing an effective ICT infrastructure and the high cost of Internet access are regarded as some of the major impediments for DCs' drive towards development and competitiveness and a major factor in further widening the digital divide. Although many governments and private organizations in DCs are waking up to this situation with different initiatives, the situation still remains desperate as more recent studies have indicated. The emerging picture suggests that there are ongoing demands on the educational system to explore meaningful ways to improve and widen access to learning and provide opportunities to a larger segment of the society. As DCs strive to achieve a balance between global competitiveness and relevant context-sensitive education and training, we believe this is an opportune moment to examine new ways in which ICT can be effectively deployed in the process of human resource development which can contribute to economic and social progress in DCs.

The papers contained in this volume reflect the organization of the conference, which is clustered around the following types of contributions:

Research Papers: These are scholarly contributions, which attempt to link theoretical ideas from the literature on ICT and development to empirical data.

Research -in-Progress Papers: These contributions present on-going efforts at developing research papers with preliminary data and analysis.

Each of the contributed papers has been refereed by at least two referees who provided feedback to authors encouraging them to work on improving aspects of their papers.

We would like to thank members of the program committee listed below for their cooperation and contribution at various stages of the conference program development.

Amit Mitra, UK
Anja Mursu, Finland
Bimbo Soriyan, Nigeria
Bjorn Furuholt, Norway
Brian Nicholson, UK
Charles Uwadia, Nigeria
Chitu Okoli, Canada
Dili Ojukwu, UK
Geoff Walsham, UK
Jonathan Ezer, UK
Judith Gregory, Finland
Julius Jillbert, Indonesia
Mathew Smith, UK
Mikko Korpela, Finland
Olayele Adelakun, USA
Peter Meso, USA
Philip Musa, USA
Rogers Okot-Uma, UK
Rose Shumba, USA
Saheer Al-Jaghoub, UK
Sajda Qureshi, UK
Sandy Turner, Ghana
Savita Bailur, UK
Sherif Kamel, Egypt
Shirin Madon, UK
Soren Gigler, UK
Sundeep Sahay, Norway
Victor Mbarika, USA

Abiodun O. Bada, The George Washington University, USA
Adekunle Okunoye, Xavier University, USA

Proceedings Editors

SESSION A1: RESEARCH PAPERS: THEORETICAL PERSPECTIVES

From Digital Divides to Digital Societies

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ABSTRACT

Though discussions of a digital divide in terms of technological access are important, this paper has two other aims. Firstly, the paper looks at the notion of the digital divide and argues that it is being used as a means for mobilising action by national governments, international agencies and public/private consortia. Secondly the paper considers the digital future that is argued to be inherent in the notion of a digital divide and suggests research is needed to follow the processes of constructing knowledge/digital societies. Research in progress in Jordan is used to illustrate these themes.

INTRODUCTION

Given the virtuality of things digital, the digital divide is a useful place to start to consider how the digital rubs up with other aspects of modern life. The digital divide paradoxically links both developed and developing countries as both have recognised digital divides, perhaps looking closely at this divide can tell us more about what is going on and how policy is shaped in relation to notions of the digital? What we are particularly interested in is twofold. First, how the notion of the digital divide is being used by countries and multinational agencies as a way of mobilising action through often large scale programmes. And second, we argue that the digital divide assumes that there is a digital future – a digital society – and that everyone is going to like it. We are less certain. The paper begins by discussing the notion of a digital divide from a simplistic basis before moving on to an analysis of the digital divide that goes beyond technological access issues. We then look at the notion of an information society which, we argue, is assumed by discussions and programmes on bridging the digital divides. We seek to illustrate these themes through research in progress in Jordan.

WHAT IS THE DIGITAL DIVIDE?

Though the digital divide is a term widely used in popular, academic, and policy circles, views about what the digital divide *is* can be used to understand how different groupings see the role of technologies in changing societies and states. For example, Strover (2003:275) reviewing a history of the digital divide in the US questions the notion: *'[t]he digital divide has been a symbolic banner of politicians and corporate largesse insofar as it substituted for more direct action against inequalities of income, education, and race.*' If so, then it has been a potent symbolism as many countries and multinational agencies such as the World Bank and UNDP have supported programmes to address the digital divide and its corollary, digital inclusion (for example, the Global Digital Opportunity Initiative by UNDP and other partners (UNDP, 2002) and the World Bank's e-Sri Lanka project (World Bank, 2004)). More recently the selfsame symbolism of state intervention has been avoided by politicians showing commitment to market economics. Once again the US provides examples. The Republican administration cutback programmes addressing the digital divide comparing this divide to a 'Mercedes' divide and arguing instead for digital opportunity (Strover, 2003). Much of the debate has hinged on a digital divide being equated with the presence or absence of technologies – computers and broadband access – much as a Mercedes divide could be equated with the presence or absence of Mercedes cars. Such a simplistic notion has been rightly criticised by a number of authors and policy makers (see Warschauer, 2003; Wade, 2002) but it does leave us having to work out what are the key issues and what is the role for policy interventions in this area?

To begin with let us engage in a simple thought exercise. Picturing a divide, especially one that is to be bridged, brings to the mind's eye two separate domains that need to be brought together and can be brought together through an engineering solution as the metaphor of the bridge illustrates (see figs. 1 and 2).

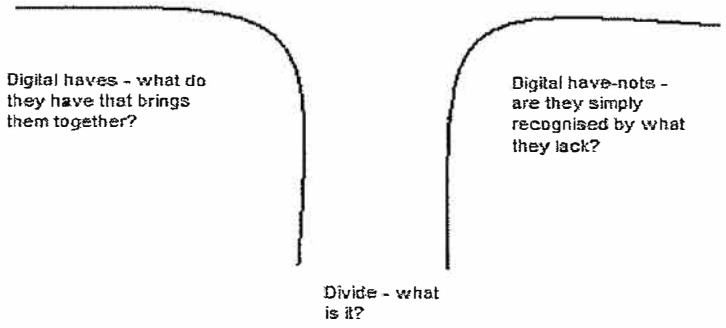

Figure 1: The Digital Divide

These simple diagrams illustrate that the digital divide is as much about the nature of the digital haves (or the concept of a digital society or information society or knowledge society) as it has to do about the digital have-nots and their means of access to the side of the digital haves. It is also focused on ways to bridge the gap usually through policy initiatives or occasionally through a reliance on the mechanisms of the market. In short, talking about a digital divide brings with it ideas about the desirability of an information/knowledge society and of an idea of progress that is enhanced by ICTs. As a recent speaker at a conference in Jordan put it: *'[w]e missed the industrial revolution, let us not miss the Digital Revolution. ... The digital divide has a snowball effect, the more delay in tackling the issue, the more difficulty to face the digital divide in the future. The potential cost of inaction is immense.'* (Sukkar, 2002). These are heady notions!

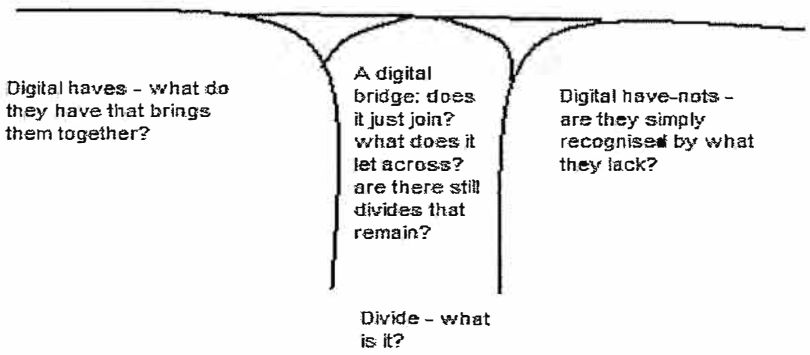

Figure 2: The Digital Divide Bridged.

The most common use of the notion the 'digital divide' refers to the difference in access to ICT infrastructure between those who have and those who do not (see WSIS, 2003a). Access can be seen as just having access to a technology such as a personal computer or access to a computer that can be connected to the internet. A number of other divides have been identified: a divide between the use of technologies in developed and developing countries; a divide in use of technologies on the basis of gender; a divide on the basis of ethnicity; a divide on the basis of age; a divide on the basis of an urban rural split and so on (see bridges.org, 2004 for a useful analysis).

Warschauer (2002; 2003a; 2003b) makes three important contributions to conceptualising the digital divide. First, though acknowledging that the concept has been useful in drawing attention to a lack of technological access, he suggests that other conceptualisations are more helpful. Second, he argues that the goal of using information technologies with 'marginalised groups' is not removing a digital divide, but rather to further a process of social inclusion. Finally, he compares the notion of a digital divide with that of a literacy divide (see Goody, 1968) and drawing on work by Scribner and Cole (1981), he argues convincingly that there is no cognitive divide between people who are or are not literate. Instead literacy has different gradations and types with people benefiting from being able to engage in new social practices than by simply having a specific cognitive skill. Developing these ideas in relation to a digital divide, Warschauer proposes that a range of resources are necessary for social inclusion. These are physical resources, digital resources, human resources and social resources.

Physical resources refer to the technology infrastructure of computers and communication devices; digital resources are the content available from digital sources; human resources are skills needed to be able to use computers and digital technologies; and finally, social resources refer to the support structures in the community. Warschauer argues that each of these resources is both an enabler of social inclusion and is then *changed* though the processes of using digital technologies.

In policy terms, Warschauer begins by examining social structures, social problems, social organisation and social relations rather than relying on technologies. Instead the social practices that already lead to people learning, collaborating and sharing can then be assisted by technological interventions. Longer term solutions are to be preferred where new practices become strongly embedded and where local people learn how to develop their own resources rather than relying on external experts. Warschauer recognises that local leadership and champions can be particularly effective and they, rather than computer experts, should become the leaders of these projects. Projects themselves should be flexible and open to innovation which can allow local understanding and involvement. Pilot projects are particularly useful in this regard. Finally market mechanisms can be used to promote access to technologies, but Warschauer considers that they are not enough and will need to be augmented by State intervention.

In summary Warschauer's empirical contributions[1], his conceptual arguments and his policy proposals are a major development in discussing the digital divide and we will return to them later. Nonetheless the term digital divide is widely used – often as a precursor for a policy initiative. Though Warschauer prefers the term social inclusion, many refer to digital inclusion as a desirable aim of policy (for example in Jordan see Toukan, 2002). In turn, an information or knowledge society is predicated when digital inclusion is discussed. The next section looks at the issue of a digital *qua* information society before considering how the digital divide has been used in recent policy statements.

THE INFORMATION SOCIETY AND THE DIGITAL DIVIDE

The idea of an information society revolves around *'a society in which ICTs play a major role in enabling people to improve their social and economic circumstances'* (Mansell, 2002: 323). There are various definitions of the information society. Webster (2002) distinguishes analytically five definitions to the 'information society', which are: technological, economic, occupational, spatial, and cultural. Our focus here will be on the technological definition, which according to Webster, is the most common definition. The technological definition of the information society refers to breakthroughs in information processing, storage and transmission have led to the application of IT in virtually all corners of society (Webster,

[1] Which we have not discussed here see Warschauer (2003a) for further details.

2002). In this society, 'ICTs play a major role in enabling people to improve their social and economics circumstances' (Mansell, 2002: 323). Castells (2000a) argues that a defining feature for the new society is that of networks and flows. He argues that our societies are fundamentally made of flows exchanged networks of organisations and institutions. However, while in the information society the whole planet is connected in a series of networks of flows, this is a selective process (Castells, 1999) as areas that are not seen to be significant for the flows are left out of the global networks (Castells, 2000b). ICTs provide the infrastructure that facilitates the work of the various networks (Castells, 2000a). It follows that an information society based on flows will always encompass inequality of access.

The making of a link between the 'digital divide' and the 'information society' can be seen clearly in the World Summit on the Information Society 2003, which was held in Geneva and was attended by a number of world leaders (ITU, 2004). The vision that was expressed in the summit is to:

> *'build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life, premised on the purposes and principles of the Charter of the United Nations and respecting fully and upholding the Universal Declaration of Human Rights.'* (WSIS, 2003a: 1).

A plan of action was proposed to achieve this vision in which bridging the digital divide is a main area that was recognised and actions were recommended to bridge this divide (WSIS, 2003b). The Summit is seen as the first multi-stakeholder effort to use ICTs to overcome the digital divide and achieve development (I-Ways, 2004a). Significant roles for donor agencies, governments and the private sector are recognised in the efforts to bridge the digital divide and achieve information societies. In the Summit a number of leaders made statements in which they showed commitment to bridging the digital divide (*ibid*).

Bridging the digital divide is promoted by a number of international organisations as a necessary condition to be transformed into information societies and achieve development. For the World Bank (2003), in order to achieve development goals, polices are needed to ensure that ICTs reach all segments of the society. For the World Bank, deregulation and liberalisation policies are needed to achieve this end. Similar to other publications, focus is on providing access to ICTs in all segments of the society.

In developed countries similar arguments are made to include groups otherwise seen as marginal in an information society. For example in England, reports demonstrate a digital divide and social exclusion between an information rich and an information poor and propose policies to alter the situation (see PAT15, 2000).

Having briefly reviewed some of the uses of the notion of the digital divide we are presented with a paradox. On the one hand, authors such as Warschauer argue that the issue is not technology but rather social inclusion in which technology plays a part. While, on the other hand, we find the notion of the digital divide being either played down within Republican America or emphasised when it comes to creating policy initiatives in other countries as our discussion on Jordan will demonstrate. In short, we think this points to the utility of the notion of the digital divide as an argument for intervention. When agencies, often the State, want to become involved in technology initiatives then the digital divide is often used as a justification. However, by the same token, if the State does not wish to become involved then the digital divide is seen as unimportant or, at worst, a transitory state of affairs which the marketplace will cure in the near future.

Two consequences flow from this observation. First, if the digital divide is used as a basis for policy intervention then, given the arguments of Warschauer, the very policies that are adopted are likely not to achieve their aims. Second, it raises the question of what a digital society, the professed endpoint of bridging the digital divide, is going to be like. We will comment on these issues by describing an example of a programme from Jordan that seeks to address the digital divide and discuss it in relation to the issues we have raised above.

JORDAN AND THE DIGITAL DIVIDE

A number of developing countries are implementing initiatives and programmes that aim to bridge the digital divide with the developed countries and within the country between the various regions (I-Ways, 2004a; 2004b). Jordan is an interesting case of a country seeking to develop using technology and education. As a small landlocked country with few natural resources and surrounded by volatile political neighbours, human resources are seen as the main resource that Jordan can capitalise on. In fact there is a consensus among all sectors in the society that human resources are the key to Jordan's future. Therefore, development through inward investment, education and ICT initiatives is seen as the way forward. Jordan is a monarchy and King Abdullah who ascended the throne in 1999 has been the instigator of much of these changes (see BBC, 2004). He calls it '*big ideas for a little country*' (*ibid*). For example, an ambitious five year programme called REACH has resulted in the formation of a Ministry of Information and Communications Technology; the introduction of legislation to make the country more attractive to investors; the establishment of a strong public – private partnership to implement the various recommended actions and the development of training programmes in a number of universities. King Abdullah and his government have been very keen to introduce technologies into schools and to improve the technical and information technology related education of Jordanian students. One major initiative in this area is called Connecting Jordanians. This initiative aims to make ICTs an important facet in the lives of all Jordanians. As a major part of this initiative, the Ministry of ICT in partnership with the Ministries of Education, Higher Education, and Planning, is establishing a broadband learning and public access network to link all schools, colleges, universities and Knowledge Stations by 2005 (MoICT, 2004). As the King said '*we've got talent, we know we can do it. It's just they [young Jordanians] need to be given the right opportunities to succeed.*' (BBC, 2004). At the time of writing, our research work in Jordan on this issue is at an early stage with the completion of a literature review and a small number of initial interviews and informal meetings in September 2004 in Jordan.

To begin with, let us take one example of a programme designed to bridge the digital divide and lead to digital inclusion. A number of Information Technology Community Centres, later renamed Knowledge Stations, have been established in Jordan in order to provide people in various areas of the country with access to ICTs. Alongside the Jordanian government, UNDP and United Nations volunteers, and other donors participated in these centres by bringing in experts and providing part of the funding with the National Information Centre as the executing agency. The centres offer training courses in a variety of areas such as computer literacy courses, specialised courses (such as computer maintenance courses and AutoCAD), and English language courses.[2]

From these centres some success stories have been made available. One example is the story of an agricultural community, which managed to solve a problem they had with water evaporation from the pool they used for irrigation. The problem was solved when a number of people who were trained in the local knowledge station contacted international organisations and were provided with funding and techniques that helped solve the problem. Examples of people who received training in local Knowledge Stations and managed to find jobs or continue their studies as a result are also mentioned (Knowledge Stations, 2004). Another success story that is highlighted is that of a young deaf girl who managed to continue her education in one of the specialised Knowledge Stations in her area. She had to leave the special education institution in the sixth grade because this was the last level available in that institution in her local area. She received training in the knowledge station which she hopes will help her in the future (*ibid*). Information on the Knowledge Stations remains patchy at the moment and is an area of on-going research. All the published information is highly positive and it is clear that these Knowledge Stations have made a

[2] Information from an unpublished background paper for Jordan Human Development Report, 2003.

difference in specific cases though how much of a difference is uncertain. It is worth noting that part two of the initiative, which is an evaluation process of the Knowledge Stations, will take place in the near future. One finding is that expectations need to be managed (Interview, Danah Dajani, Director of a Youth Resource Centre, 2005). Users of the knowledge stations thought that learning to use computers and gaining a certificate in ICT use (called an ICT driving licence) would enable them to get a job in the ICT area. This was not the case and many people were very disappointed.

There are four features of technology led development in Jordan that we would like to draw attention to – the role of external agencies; the intervention of the state based on programmes and partnerships with non governmental and private sector organisations; thirdly, the uncertainty of these programmes as both political, social and technical interventions, and finally, considering the nature of where digital inclusion leads to.

Firstly, let us look at the key role of external agencies in the development of Jordanian programmes. These take several forms. The US government has been financing digital initiatives for the last seven years in Jordan. Jordan is highly dependent on western aid which amounted to $1bn from the US alone in 2003. The US through the USAID programme has also supported initiatives such as the REACH programme. In the summer of 2004, the White House announced the inclusion of Jordan in the US Digital Freedom Initiative (White House, 2004). As the communiqué states: '*[t]he United States is committed to helping countries bridge the digital divide and generate economic growth and opportunity.*' (*ibid*). It is a public-private partnership that is aimed at assisting small and medium sized businesses and local business associations while helping to support policy making in the areas of e-commerce and competitive telecommunications.

A second external source of assistance has been the use of agencies such as UNDP and the adoption of a successful Canadian programme designed for digital inclusion. In 2000, int@j, a private sector ICT association, and the then Ministry of Posts and Communications invited Doug Hull of Senior Director of a Canadian institute known as CANARIE to assist in formulating a strategy which was the beginnings of the Connecting Jordanians programme (int@J, 2000). This workshop had three areas of interest: infrastructure which looked at both physical infrastructure and the legislative framework. The second focus was on content and how to develop Arabic and relevant content and the third area was on the digital divide and put forward a Canadian programme as an example of how to introduce access centres in difficult locations at an affordable cost. A radical rethinking of the education system has also been underway based on call by King Abdullah in February 2001 for a 'remodelling' of the education system to meet the demands of new and emerging economies (Toukan, 2002). The aim is to change the school system from a 'schooling' system that is teacher centred, information based, centralised and directed towards a 'learning' model which is student centred, knowledge based, devolved and encourages initiative. Technologies are seen as central to the learning model which began by teaching teachers how to use technologies coupled with the introduction of computers in schools with the aim to have a computer for every ten school children by 2006.

To support the above programme, a third source of assistance has been actively sought – multinational companies. Cisco, Dell, IBM, Hewlitt Packard and Microsoft have all provided a variety of resources and some of their contributions have been put together with non profit agencies to create the Jordan Education Initiative in 2003 (WEF, 2003). As John Chambers, the Cisco CEO said '*It is truly an honour to be part of such a groundbreaking educational model where private, public and non-profit organisations come together to drive the marriage of education and technology for the greater good. My hope is that the Jordan Education Initiative becomes the model for increasing the educational opportunities and standard of living on a global basis.*' (*ibid*). Companies are also providing assistance in other programmes. For example, Hewlitt Packard in association with Relief International – schools online have set up four digital community centres which provide computers, internet access, and human capital in the shape of administrators, trainers and support staff. A major objective of these centres is ensure access to high-skill jobs in the ICT sector (AME Info, 2004)

The form of the process of digital inclusion/bridging the digital divide is our second issue. It is very noticeable that King Abdullah is very visible as the initiator of ideas as, for example, the Minister of

Education, Mr Toukan, refers above to the King as the initiator of reform in education (Toukan, 2002). The King appears to be very able in putting Jordan's case to foreign governments, heads of state, and international institutions. For example, he has been instrumental in having the World Economic Forum meet twice recently in Jordan. Aspects of the structure of government have been changed. For example, a Ministry of Information and Communications Technology was created in 2002 to oversee much of the development of ICT related issues in Jordan. A rapid programme of legislative change has occurred. The joining of the WTO in 2000 was an initial impetus for change as much of Jordan's economy had to be opened up to allow other companies to compete. Legislation to safeguard intellectual property rights was passed quickly. In Jordan, it is clear that int@j, the private sector ICT association, lobbied strongly for certain legislative changes as part of the REACH programme and the government made many of the requisite changes (REACH 4.0, 2004). Another feature of the process has been the creation of public/private partnerships such as the REACH programme to promote foreign direct investment in ICT and the Jordan Education Initiative discussed above. Here, neither the government nor the private sector are able to work alone, both need each other and both need access to foreign aid and assistance. These collaborations are always structured as projects with predefined aims and timetables that report and are reviewed at regular intervals (for example the REACH reports). In short, the advent of programmes centred around ICTs has led the government to restructure itself and to engage with overseas and local companies to create a variety of programmes seeking to achieve a number of objectives. But will they work?

King Abdullah is very clear about the risks he is taking in spearheading a drive to use ICTs in Jordan. Recently, in an interview with the BBC, he said ' *[w]hen I looked at education, and I said I wanted to put computers in schools so that every student has a chance at education, there was a traditional reaction – "we need food on the table not computers" ... but what makes the difference between someone who's poor and who's rich, for their children, is education.'* (BBC, 2004). Commentators argue that he is gradually eroding his own political standing if no effects of change are seen in the near future (*ibid*). In an unstable and turbulent region, attracting foreign direct investment is not easy and is very susceptible to events that occur beyond Jordan's borders. Moving to the technical and economic issues surrounding initiatives such as Connecting Jordanians, it is still very unclear whether there is enough investment in technological infrastructure and in training and support for this initiative to meet its own expectations. Using the prospects of technology and a new economy to reform education and improve access of other groups to technologically based centres appears to be a long term strategy, whereas Jordan, like many other places, is under pressure to produce short term results.

Our final issue is a questioning of where digital inclusion leads? The rise and fall of the dot.com economy is well known. However, we believe that both the rise of the new economy and its early demise are often exaggerated with much of the hype driven by attempts to create and manage marketplaces by vendors of technologies and consultant companies. Nonetheless, it is sobering to see a number of countries, Jordan included, committed very forcefully to a mode of operating whose future remains unclear. Members of the government have made the valid point about what other choices are available to a country such as Jordan (see Toukan, 2002). In other countries where broadband access and computer access is reasonably high such as the UK there remains a large minority that has been seen as excluded from these developments (see PAT15, 2000). For users of the internet, the consequences of a digital society remain somewhat ambiguous. Warschauer (2003) points to how disadvantaged groups in the US are able to negotiate better discounts over the internet from car dealers than by face to face contact and we are sure there are numerous interesting and progressive examples to be found of the benefits of digital inclusion. However, use of the internet is an area where pornography is ubiquitous, where problems with computer viruses are widespread, in which technologies remain unstable, where the language is mainly English not Arabic, and where businesses using high bandwidth communications are increasingly able to shift the locations of their investment. For any country, it is important to recognise that digital inclusion is a mixture of wanted and unwanted effects which cannot be managed by states or others. In a country such as Jordan, these issues are perhaps more pertinent than in many other places.

DISCUSSION

Wade (2002) provocatively has questioned whether the moves to bridge the digital divide led to a new form of development or lead to an increasing dependency. He argues that a group think has gripped many policy

makers which states that the existence of a digital divide is important and that ICT centred development is the way to improve the situation. More controversially, he suggests that any evidence of failure is seen as poor management of projects or due to cultural considerations which can be resolved by better managed future projects. Certainly both the policy and academic literatures abound with discussions on computer and broadband access (see for example, Dutton *et al*, 2004). Obviously access to a digital society has to be mediated through technologies. But, keeping the emphasis on technologies, raises the question of who benefits from this state of affairs. As Wade suggests, it is hard to avoid the suggestion that one major beneficiary is the hardware, software, and consulting industry. Most of this industry is based in the G8 countries and a large majority of them are US companies. Though we agree with Wade's analysis, we are making a different point: what is the digital economy/information society that is to be found after the digital divide has been crossed? One component will be increased dependency on multinational providers of hardware and network services though moves towards open source software and cheaper hardware (perhaps produced in the developing world?) may be an improvement. What perhaps is less discussed is the notion of a future information/digital society. To understand what this may be like, we can go to exemplars of countries which have high digital access – the Scandinavian countries are one example. Other European countries and the Anglo American experiences give us others. Immediately it is obvious that there is both similarity between these different countries and also considerable differences. In short, it is difficult to generalise what this society might be and how it is changing. For a developing country such as Jordan, the task is much greater and one aspect of the research we are undertaking is to understand the diverse ways that digital technologies are currently used in Jordan.

We are not convinced that digital technologies lead to social inclusion as such and agree with Warschauer that this task is complex and often involves working on small scale initiatives rather than large scale projects. It is too early to say what the effects will be of the Connecting Jordanians programme though we might expect that a large scale project might prove more difficult. Having said that, the argument being made by policy makers in Jordan is that this investment in ICTs as related to education and building human resources is an investment in the future of Jordan, the results of which will be evident in the next generation. The assertion is that ICTs are being introduced in education at an early stage as part of the curricula and this is complemented by the other initiatives. Therefore, the coming generation will have grown up with ICTs, which will have its effects on Jordan's development and its transformation into a knowledge-based economy.

The term digital inclusion has much to recommend it as there is no *apriori* reason why technologies lead to social inclusion through they must lead to some form of digital inclusion. What we do see in other countries is threefold. First, it is difficult to speak of digital technologies as all having similar characteristics. For example, mobile phones have a high penetration in Egypt (and in Jordan) but internet access has not, yet both are digital technologies (see Sharif, 2004). Second, the use of digital technologies creates a greater access to world wide digital resources. This may sound trite, but the key issue is that they are digital resources. For all states, this means that their citizens have access to barely regulated and diverse resources. Most of the content will be in English and much of the content will probably be undesirable. Finally, the role of the state in these arrangements is fairly peripheral. Control is ceded to bodies such as ICANN who regulate domain names and to companies, organisations, and people who use the net. This is not anarchy, but it is a long way from the ideas of planned development.

CONCLUSION

We have sought to discuss the digital divide by first looking at it as a concept and arguing that the notion of the digital divide is as much about a digital society as it is about mechanisms to include other groups. The paper went on to look at discussions that have moved beyond issues of technological access. We then looked briefly at the idea of an information society to give us some purchase on what a digital society might be. Our argument is twofold: first, we suggest that discussions about a digital divide are often being used as ways of intervening and creating technologically based projects. These projects benefit the state, by giving a programme of action, and they benefit other agencies notably multinational companies and consultants. However, digital inclusion through bridging the digital divide should lead to a digital society and we argue that an emerging digital society needs much more detailed research based on what people, organisations, companies and governments are doing using digital technologies. We speculate that the

outcome of a digital society may not be as pleasant as many programmes expect it to be and we illustrate some of these themes using the case of Jordan which is research in progress. Perhaps the outcome of this paper is a call for more research on the nature of the digital societies/economies that are emerging in developing countries to complement studies of technological introduction and the like. Much good work has been done and there is a lot more to do.

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Reconsidering ICT for Development Research: Critical Realism, Empowerment, and the Limitations of Current Research

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ABSTRACT

This paper argues that the ability to enhance human resources through Information and Communication Technologies (ICT) can only come about through an understanding of the causal linkages between the application of ICT and particular outcomes. For example, just knowing that there is a relationship between ICT and employee empowerment is not enough. We need to know why and how the relationship works. However, understanding these links is as contentious as it is important. The current state of ICT for development research has come up against philosophical impasses that limit constructive and critical research. To move past these limitations, a healthy re-examination of their underlying ontological assumptions is in order.

This article offers one such reconsideration. It proposes that critical realism, specifically as developed by Bhaskar in A Realist Theory of Science and The Possibility of Naturalism, offers a viable and appropriate philosophical underpinning for ICT for development research. Critical realism does so through a coherent response to post-positivistic epistemic skepticism by providing a qualified (non-positivist) naturalist approach for the social sciences.

This paper proceeds in three stages. The first stage describes the nature of the researcher's dilemma. The second stage provides an introductory description of some of the more salient aspects of critical realism as a philosophy of science that provides one route to overcome current research difficulties outlined in stage one. The final stage applies critical realist assumptions to IS research in the development context. To clarify the discussion and render it more relevant to human resource development this section includes a realist conceptualization of the relationship between ICT and employee empowerment and what this means for research. This example shows how critical realism effectively dissolves debates such as the dystopian/utopian argument over IS and empowerment and provides a new conceptual apparatus that will improve human development research and practice in the future.

1. INTRODUCTION

Technologies have long been implicated in shaping man's history and this role has arguably increased with the development and diffusion of information and communication technologies (ICT) (Castells 2001). In theory, ICT can help bring about positive social benefits. For example, a typical belief is that employees will be both functionally and politically empowered through the application of information and communication technologies. Intrinsic in this belief is a postulated causal connection between the application of ICT and particular developmental (social, economic, political) outcomes.

Unfortunately understanding these causal links has proven more difficult and contentious than appears at first sight. These difficulties stem, in part, from the current dominant discourse of positivism and interpretivism within the IS literature. Such a condition begs for a healthy reconsideration of the one's philosophical assumptions. To that end, this article presents a new approach for ICT for development research based on the philosophy of science of critical realism (CR) as developed by Roy Bhaskar (1978; 1998).

This paper proceeds in three stages. The first stage describes the nature of the researcher's dilemma. The second stage gives an introductory description of some of the more salient aspects of critical realism as a philosophy of science. The final stage applies critical realist assumptions to IS research in the development context. To clarify the discussion and render it more relevant to human resource development there is a consideration of a realist conceptualization of the relationship between ICT and employee empowerment and what this means for research.

2. ICT FOR DEVELOPMENT RESEARCH

Orlikowski and Baroudi (1991) found that IS research is dominated by two paradigms of research; positivism and interpretivism. Regardless of the appropriateness of the categories, it is indisputable that these characterizations shape IS research as evidenced by the continued debate over their similarities and differences (e.g. Fitzgerald and Howcroft 1998; Lee 2004; Weber 2004).

Positivism is commonly associated with quantitative and statistical techniques. This simplistic association misses out on two underlying aspects of a positivist methodology that still influence social science research today; the Popper-Hempel 'Hypothetico-deductive' model of scientific explanation (ibid: p.10) and a reliance on the Humean notion of causality as a constant conjunction of events (Bhaskar 1978). It is these (causal) conjunctions of events that form the basis of our knowledge, i.e. universal laws.

The impact of positivist assumptions is still prevalent (although diminishing) in IS literature and research (Avgerou 2000: pp.573-574). For example, it is clearly manifest in the polarized "utopian techno-enthusiasm" and "paralysing anti-technology" (Avgerou and Walsham 2000) literatures that are predicated on law-like relationships between technology and social outcomes. However, the implementation of technology has proven not to entail such a straightforward causal relationship as the process is fundamentally shaped by the practices of humans in every-day life such as hacking, tinkering, and improvisation (Ciborra 2002). For example, evidence shows the history of ICT implementation in the development context is most accurately characterized by its degrees or types of failure rather than its successes (Heeks 2002). Obviously something deeper and more complex is transpiring.

Discontent with positivist research in the social sciences has led many researchers to gravitate towards interpretivism. Interpretivist studies are characterized by the prioritization of "subjective meanings and social-political as well as symbolic action in the process through which human construct and reconstruct their reality" (Orlikowski and Baroudi 1991: p.13). For example, Schech (2002) rejects the current pro- and anti-technology arguments of the (positivist underpinned) modernist and structuralist positions respectively. Instead, she argues for a post-modernist position that ICT needs to be examined in terms of a power/knowledge discourse. Avgerou and Walsham (2000), wish to overcome this dichotomy with "a broadly interpretive" approach that focuses on diverse cultures, socioeconomic conditions, and the "experiences and perceptions of the actors involved" rather than through an "objective 'scientific' framework of hypothesis testing" (ibid: pp.2,7).

Interpretivist research is more than just a focus on human constructs and society as the prime (if not only) drivers of change. There is also a rejection of the positivist notion of causality. This results in either a rejection of causality completely (Guba and Lincoln 1989), or of the acceptance of the multidimensionality (Symons and Walsham 1988: p.119) or circularity (Orlikowski and Baroudi 1991: p.14) of cause and effect. Consequently, some interpretivists argue that it is "naïve" to think that social science can harness the "potential impact" of technology through "informing correct choices of action" (Avgerou, Ciborra et al. 2004: p.4). The positivist notion of prediction is rejected in favor of the goal of understanding the diverse meanings of stakeholders. One consequence of this position, however, is the impossibility to discern contingent effects from necessary ones (or a rejection of the distinction between them). This is because a complete description of any cause would require a full historical account leading up to the outcome (Bhaskar 1978: p.77). Hence the logical conclusion that interpretive research should focus on context (Walsham 1993; Avgerou and Walsham 2000).

However, this perspective is problematic. If we can not discern between contingent and necessary causal factors then how can there be any knowledge gained from research or any notion of generalization? Indeed this skepticism is inherent in the strong constructionist position (Orlikowski and Baroudi 1991: p.15; Crotty 1998: p.63-64) that all knowledge and beliefs are equally valid and "there are no correct and incorrect theories but there are interesting and less interesting ways to view the world" (Walsham 1993: p.6).

This relativism has been decried by some as a "paralyzing 'anything goes' attitude" (Avgerou 2002: p.65) and comes at a cost. First, there exists a contradictory relationship between this relativism and generalization. On the one hand, many interpretivists accept (at least implicitly) the possibility of generalization (Williams 2000). On the other hand, given stated interpretivist assumptions, these researchers are faced with a basic contradiction. If there is no rational basis to choose between competing theories then how can one justify any particular generalization?

Second, this denial of judgmental rationality is an implicit anti-intellectualism that can only discourage *critical* analysis and debate (Groff 2004). Epistemic relativism quickly slides into moral relativism making any moral statement problematic – even in the face of grave injustices. Indeed as Probert (2004) argues, there is a fundamental incompatibility between interpretivism and critical theory. This incompatibility stems from, as Bhaskar (1998) argues, the reduction of the social sciences to subject-subject relationships and thus fails to position them in reference to some aspects of reality that allows for the "possibility of rationally defensible conceptual criticism and change" (ibid: p.21). If there is nothing objective and knowable outside of human subjectivity (or intra-subjectivity), then an ICT for development researcher must deal with the intuitively and empirically contradictory position that research cannot incorporate situations and concepts like poverty, social inequality, and power relations as objectively real and in some way causally efficacious phenomena.

Noting these contradictions between theory and practice is fundamental to the argument presented here. Eventually, when there is an incompleteness in philosophy, theory-practice inconsistencies will emerge (Bhaskar 1998: p.15-16). It is these moments of contradiction that should spur both philosophers and practitioners alike to engage in ontological re-considerations, to uncover what is lacking in the underlying philosophy. If a new account emerges that has greater consistency and resolves these contradictions then there is a powerful argument for accepting this new conceptualization as an improvement upon the first. The following section argues that critical realism is one such account.

3. CRITICAL REALISM

Many have argued for the usefulness of critical realism as a philosophical underpinning for the social sciences in general (Miles and Huberman 1994; Stones 1996; Pawson and Tilley 1997; Sayer 2000; Robson 2002; Danermark, Ekstrom et al. 2003; Carter and New 2004) as well as organizational research (Mingers 2000; Fleetwood and Ackroyd 2004), health and social work (Houston 2001; Kazi 2003), and information systems (Dobson 1999; Dobson 2002; Carlsson 2003; Mingers 2004a; Mingers 2004b), to name a few. This popularity stems in part from its ability to transcend some of the classic dualisms in the social sciences such as positivism vs. interpretivism, and structure vs. agency (Bhaskar 2002: p.19-22). The following subsections set out the main tenants of CR with a focus on the 'realism' component. While the 'critical' element is crucial and fundamental for ICT for development research, it falls out of the scope of this paper.

3.1. Scientific Realism

Crotty (1998) in *The Foundations of Social Research* lays out what he views as the four main elements of social research; epistemology, theoretical perspective, methodology, and methods. He explicitly excludes an in-depth discussion of ontology as, "ontological issues can be dealt with adequately without complicating our four-column schema further by expressly introducing ontology" (ibid: pp.11-12). Bhaskar turns this enterprise on its head. The starting point for CR is ontological, not epistemological. When Bhaskar (1998) was developing his critical naturalism for the social sciences, he asked, "what properties do societies and people possess that make them possible objects of knowledge for us" (ibid: p.13)? In other

words, instead of asking how we can know something, a scientific realist asks what the world must be like to generate a particular phenomenon. It is only when we have a working hypothesis about what exists can we attempt to know it – or even understand how it is *possible* to know it! Epistemology can only follow from a consideration of ontology.

Bhaskar's first conclusion is that for science to happen there must be a reality independent of our knowledge of it. A distinction is made between intransitive and transitive objects of knowledge. Intransitive objects are the world of things and structures that are independent of our knowledge of them. As Searle (1995) would describe it, these are the "brute facts", that are objective "in the sense that they are not a matter of your or my preferences, evaluations or moral attitudes" (ibid: p.1). The transitive objects are the "raw materials of science – the artificial objects fashioned into items of knowledge by the science of the day" (Bhaskar 1998: p.16). Thus, while our knowledge of the world (transitive) constitutes a part of the world (intransitive) the existence of the world is not dependent upon this knowledge.

Critical realism takes on board post-positivist critiques by combining ontological realism with an epistemological relativism (Archer, Bhaskar et al. 1998: pp.x-xi). Scientific knowledge is seen as socially constructed, political, and fallible. However, this does not logically entail that all knowledge is *equally fallible*. Indeed, CR asserts that the relation between theories/theoretical concepts and the properties or objects they represent is not unambiguous and simple; nor is it necessarily arbitrary (Danermark, Ekstrom et al. 2003: p.116). This leaves room for judgmental rationality to choose competing theories. However, theories should be apprehended in an undogmatic way; they are fallible and changeable and there will always be a number of competing theories (ibid: p.117). For this reason CR is characterized as ontologically bold, but epistemologically cautious (Bhaskar 1998: p.176).

For Bhaskar, relativists and logical positivists commit an 'epistemic fallacy' that reduces or analyses statements about *being* in terms of statements about *knowledge* (Bhaskar 1998: p.27). For example, logical positivists commit this fallacy when they claim that a proposition is meaningless unless it is empirically verifiable (ibid: p.28). Another example can be found in Avgerou's (2002) book *Information Systems and Global Diversity*. Avgerou can be interpreted as committing this fallacy when she writes, "that diversity as a social condition cannot be ironed away with universalistic theories and practices implies a relativist stance" (ibid: p.65). It does not logically follow that because universalistic theories cannot adequately explain social diversity that the world is such that there can be no rational basis for deciding between competing claims. These are two separate issues. Instead, Avgerou is confronted with the problem of the inability of universal laws to adequately explain the diversity she refers to. At the same time, much interpretivist work of Avgerou's kind advances theories of local adaptation that in fact provide at least a partial explanation of processes at work that can account for such empirical diversity. Fortunately, explanation in the social sciences need not be limited to universalistic theories or relativism. Instead, what is needed is a philosophy of science consistent with Avgerou's approach. As we will see, CR is one such approach, allowing for non-Humean non-universalistic theories that explain and are generalizable while insisting on the importance of the local context and social diversity.

3.2. Transcendental Realism

Besides the transitive/intransitive differentiation, CR accepts a three-fold ontological stratification between the distinct domains of the real (what exists), actual (events), and empirical (observable events) (see Table 1). The real is constituted by things, not events. What exists are both social and physical phenomenon with their particular structures and capacities to behave in particular ways (Sayer 2000: p.11). These capacities to behave are termed generative mechanisms, that, simply stated, "[are] nothing other than the way of acting of a thing" (Bhaskar 1998: p.38). It is these mechanisms that combine to *generate* the flux of phenomena that constitute the actual states and happenings of the world (ibid: p.34). When a causal power in the domain of 'real' becomes activated (actualized) the result is referred to as the 'actual'. Finally, the domain of the empirical consists of those events that are observed.

	Domain of Real	*Domain of Actual*	*Domain of Empirical*
Mechanisms	✓		
Experiences	✓	✓	
Events	✓	✓	✓

Table 1 Adapted from (Bhaskar 1978: p.13).

These structures also are stratified in another sense. Some structures emerge from a combination of structures and have qualitatively different causal powers that are irreducible to their constituent parts. For example, the combination of two hydrogen molecules with one oxygen molecule results in water whose emergent properties are new and very different than those of the parts taken separately (Sayer 2000: pp.12-13).

It is important to understand that the nature of real objects at a given time does not pre-determine what will happen (Sayer 2000: p.95). Instead the structures of objects *enable* what *can* happen through the workings of their mechanisms within geo-historical contexts (ibid: pp.12,15). In this sense, mechanisms can be better thought of as the *tendencies* of structures and not universal laws. The goal of realist research, as we will see, is the *understanding* and *explanation* of these mechanisms (Houston 2001: p.850).

This notion of mechanisms is sustained through the very real *ontological* distinction between the structures, their causal powers (tendencies), and the events they generate. This has important implications. For example, there are many interacting mechanisms whose actualization never reaches the realm of the empirical. Thus the causal powers that ground the natural mechanisms may endure and thus be "both applicable and true (that is, not falsified) though its effect (i.e. the consequent) [is] unrealised" (Bhaskar 1998: p.11). In this sense reality runs much wider and deeper than that to which our senses allow access.

3.3. Social Ontology

Social change is brought about through the activity of individuals. Individuals' meanings, interpretations, and reflexive actions are thus an essential part of the causal mechanisms operating in a setting (Sayer 2000: p.27). Individuals, however, do not act in a social vacuum. The internalization of social institutions is a pre-requisite for the understanding of others and "for the apprehension of the world as a meaningful and social reality" (Berger and Luckman 1967: p.130). Consequently, it is only within society that one can engage in intentional human action (Bhaskar 1998: pp.34,36-37). These societal structures are the relatively enduring products of conscious social activity. In a dialectical process, people reproduce and occasionally transform the structures that are then experienced as objective reality and act back upon the individuals who reproduced them (ibid: p.34). Contrary to individualist sociology, these structures are not reducible to these human activities (ibid: p.27). They exist as both objective and subjective reality (Berger and Luckman 1967; Searle 1995).

Bhaskar argues that one can posit the existence of these social forms via their causal efficacy. For example, though phenomenon such as class structures or forms of domination may not be amendable to direct observation and measurement, their effects on social life may be clearly detectable – for example with the existence of various kinds of oppression and control that accompany domination (Layder 1998). Secondly, the fact that social structures exist prior to human activity establishes its autonomy and partial independence from these activities (Bhaskar 1998: p.25). For example, most current institutions of higher learning pre-existed the attendance of their currently enrolled students. However, now that these students are members of that institution they are constrained and enabled by its structures while the students unconsciously (and sometimes consciously) reproduce and transform these structures.

Of course, the only visible outcome of the causal efficacy of social structures is vis-à-vis individual behavior. The potentialities of social structures are necessarily mediated through the individual. Archer characterizes this mediation as an "objective influence which conditions action patterns and supplies agents with strategic directional guidance" (Archer 1995: p.196). Thus, for Archer, situational evaluations are

influenced by both the socially emergent phenomenon that supply material reasons and the culturally emergent phenomenon that supply normative reasons (ibid: p.212). In this conception, the overly deterministic notion of social structures as the strings controlling a marionette are replaced with the metaphor of the rules of chess or the blueprint of a house (Groff 2004: p.110). Individuals are enabled and constrained, but still maintain a degree of voluntarism. Thus Archer proposes a methodology of analytical dualism that asserts the relative autonomy of both structure and agents and allows for the exploration of the interaction of these entities through time (Archer 1995; Archer 1996).

An important characteristic of these emergent structural mechanisms is that they are intrinsically relational. Their existence and their influential powers emerge through social combination – by virtue of these interrelations (Archer 1998: p.192). Thus, causal powers and liabilities can reside in complex social structures such as social relations and organizational structures (Pawson and Tilley 1997: p.64). Sayer (2000) provides us with a helpful example; "In the social world, people's roles and identities are often internally related, so that what one person or institution is or can do, depends on their relation to others; thus what it is to be a tutor cannot be explained at the level of individuals but only in terms of their relation to students, and vice versa" (ibid: p.13). These internal (necessary) relations need to be contrasted with external (contextually contingent) relations. While internal relations determine *what* exists, external relations between social objects determine *whether* and *how* what exists will manifest itself (Danermark, Ekstrom et al. 2003: p.187).

4. REALIST ICT FOR DEVELOPMENT RESEARCH

This section considers the implications of adopting a CR philosophy for the conceptualization and research of ICT for Development projects. Realists like Pawson and Tilley (1997) view social programs as the introduction of causal potentials that provide reasons and resources (material, cognitive, or emotional) that enable participants to change (ibid: p.215). Social change is brought about through the actions of the stakeholders acting on the causal mechanisms introduced by the ICT for Development project interacting within a specific context. A "successful" program is one that "break(s) into the existing chains of resources and reasoning which led to the 'problem'" (ibid: p.75) as characterized by the program theory of change.

These program mechanisms and stakeholders are also embedded in a stratified reality of a pre-existing and changing "range of attitudinal, individual, institutional, and societal processes" (ibid: p.216). This stratified reality has its own set of mechanism and causal tendencies. The result is that these mechanisms can operate simultaneously, sometimes reinforcing and other times contradicting each other (Houston 2001: p.851).

This discussion highlights two features of an ICT for development intervention; stakeholders as the drivers of change and the embedded nature of the program. The contingent actualization of program mechanisms dependent upon both stakeholders and the context implies that it is too simplistic to argue that ICT for development projects 'work' or 'fail'. A realist expects the same mechanism to "fire, misfire or go completely unnoticed according to circumstances" (Pawson 2004: p.33). Thus a realist seeks to "understand *why* an IS initiative (IS implementation) works through an understanding of the action mechanisms ... and to understand *for whom* and *in what circumstances (contexts)* an IS initiative works..." (Carlsson 2003: pp.14-15).

4.1. Theorizing Mechanisms

Understanding structures and mechanisms places the focus of research on conceptualization and description while the search for regularities becomes relevant but downgraded (Sayer 2004: p.11). Indeed, regularities are only a potential indicator of underlying structures in action as "events may be unsynchronized with the mechanisms governing them or may be affected by different, sometimes countervailing, influences" (Higgs, Jones et al. 2004: p.93). Thus, realist explanation involves the uncovering of the underlying structures and mechanisms that co-determine a particular empirical outcome.

The realist method of science that hypothesizes these often unobservable mechanisms is termed retroduction (Archer, Bhaskar et al. 1998). Retroduction begins from the unexplained phenomenon and hypothesizes about what mechanisms might exist to generate it. Stones (1996) explains, "Retroduction, for sociology, involves the postulation of social objects of mechanisms, with definable powers, whose existence or activation is thought to be making, or to have made, a significant causal contribution to a social phenomenon that a sociologist wants to explain" (ibid: p.37). It is a transcendental argument that seeks to clarify the basic prerequisites or conditions for social relationships, people's actions, reasoning and knowledge (Danermark, Ekstrom et al. 2003: p.96).

The logic of realist explanation is summed up nicely by Pawson and Tilley (1997) and is worth quoting in full;

> 1. "The basic task of social inquiry is to explain interesting, puzzling, socially significant regularities (R). Explanation takes the form of positing some underlying mechanism (M) which generates the regularity and thus consists of propositions about how the interplay between structure and agency constituted the regularity. Within realist investigation there is also investigation of how the workings of such mechanisms are contingent and conditional, and thus only fired in particular, historical or institutional contexts (C)" (ibid: p.71).

This is summarized nicely by Pawson and Tilley in the following simple equation (ibid: p.xv) (where the socially significant regularities are now 'outcomes');

$$\text{Context(C)} \quad + \quad \text{Mechanism(M)} \quad = \quad \text{Outcome(O)}$$

4.2. Realist Research Cycle and Generalization

Simply hypothesizing underlying structures and their mechanisms is not the full story. Researchers define a phenomenon, construct explanations for them, and then empirically test these explanations that in turn become the phenomenon to be explained (Bhaskar 1998: p.12). Realist research is a cyclical process where theory and empirical data are brought into a dialogical relationship in a constant effort to test and refine the theories.

Given the perspective that CMO configurations constitute an explanatory account, it is possible to see how to generalize. From the above discussion, it should be evident that broadly sweeping generalizations across families of interventions (e.g. ICT will empower employees through information provision) are neither possible nor desirable (Pawson 2004). Instead the 'secure transferability of knowledge' results from the abstraction of the essential (necessary) conditions for the observed behavior from the specific CMO configuration instances (Pawson and Tilley 1997: chap 5). The result is a mutable and hopefully continuously refined typology of abstracted CMO configurations.

These CMO abstractions can be used as analytical frameworks which then can be tested and refined in a new case study situation. Only after having come in contact with the empirical can a researcher hypothesize the CMO configurations responsible. This is not to say that data speak for themselves. Instead, a researcher can best "conceptualize events, mechanisms and internal relations in a certain way, with the help of theories" (Danermark, Ekstrom et al. 2003: p.120). Indeed, "scholarly knowledge of the subject is crucial" (Sayer 2000: p.23) as is important to draw on broader literature, theoretical perspectives, and case-studies that may provide background "stimuli" in the form of sets of concepts and chains of reasoning (Layder 1998: p.40). This dialogical relationship serves a purpose beyond generalization. The refined understanding of both the internal *and* external relations is essential for the understanding and continual betterment of practice at that local situation (ibid: p.119).

5. EMPOWERMENT

Now we have the theoretical tools to move to the example of empowerment. For a realist, people possess powers (dispositions) that "exist by virtue of their physiological and social make-up" (Fleetwood 2004: pp.46-47). It is the actualization of these powers that results in particular activities. These activities constitute work when they are "performed within internal social relations structuring the sphere of necessity" (Karlsson 2004: p.103). Thus, work is only work as an activity if it is embedded within a particular set of social relations. Furthermore, power in the workplace is also a function of these internal social relations that work to constrain and enable the activities of workers.

This implies that empowerment is a process that vis-à-vis individual actions transforms the internal and external social relations that constitute the power relations and *not* viewed as simply a set of behavioral outcomes such as participation. As Clement (1996) writes, empowerment "is not so much received as a gift or an obligation, but claimed through ongoing individual and collective actions – actions that can be aimed at improving the *conditions* of work as much as they are aimed at its *products*" (Clement 1996: p.385). In this sense, Psionos *et. al.'s* (2000) definition of empowerment as the decentralization of decision-making authority (ibid: p.213) is close to a realist position, as it focuses on the underlying causal powers and structures.

This perspective allows us to see the limitations of O'Neil's (2002) framework of community technology center evaluations. Merging many pieces of research, O'Neil assembles a list of indicators for empowerment (among other things) such as capacity for collective action, ICT penetration rates, level of two-way information flow etc. O'Neil states, "[empowerment] can also be considered as an outcome variable in community projects if capacity building is a major activity of the project" (ibid: p.80). While such research might prove a useful starting point, it runs the risk of mistaking the outcome indicators for empowerment itself. Indicators are the ontologically distinct outcomes of individual practices. The outcomes *may* be empirical realizations of activities of workers within transformed internal social relations. The data alone do not uncover the tendencies at play that have generated or enabled (or worked to disable) that outcome.

The empirical often belies the real. For example, the flattening of a hierarchical organizational structure (transforming internal relations) may result in the decentralization of decision-making powers. Whether or not these new powers are manifested by individuals will be highly influenced by external relations (contextual influences, individual choices etc). Or, consider that decision-making powers and activities of lower-level workers may stem from external relations that are specific to the local context and *not* from any realignment of the internal relations of the organizational structure. For example, imagine a community with a culture of high trust. Trust can be seen as a structure that emerges from a particular type of social relation that is shaped by reciprocal interactions and based on mutual rights and obligations (Reed 2001). These structures have mechanisms that are potentially causally efficacious in that they provide the managers with reasons to have more confidence in the behavior of the lower-level workers. Thus the manager might accord them significant decision-making authority without the need for a real transformation of the structural internal relations. A manager may still have the power to make the decisions but chooses not to exercise that potential. However, one day, if betrayed that trust, the manager may choose to exercise the very real power inherent in this relationship.

This perspective is then in agreement with Clement (1996) that the dystopian/utopian debate over IS and empowerment is a non-starter – such a position can only be predicated on positivistic notions of causality. It follows that ICT can be seen, in agreement with Psionos *et al*, as a *support* for empowerment, and not the means. Technology introduces resources and ideas that may enable workers to change their practices and potentially transform or reproduce internal social relations, but these practices are also constrained and enabled by the structures in which they are embedded.

6. CONCLUSION

Improving our ability to enhance human resources through ICT is an admirable and attainable goal. However our ability to research such issues, even ask such questions, are compromised in the current discourse of positivism and interpretivism. Indeed, the questions posed by ICT for development researchers are ones that cause deep tensions between our quest for scientific knowledge, respect for diversity, and our moral sensibilities. However, while limited, this does not imply that all research under incomplete or false assumptions is for naught. Despite these tensions and internal contradictions most research remains necessarily true to (and constrained by) the reality that the research is trying to explain. For example, Walsham (2003) draws attention to important issues when he argues for research to take an interpretivist approach with a critical focus on issues such as social inequity and power relations, despite the internal contradictions discussed above. Indeed, the ineluctable emergence of theory/practice contradictions that result from incomplete philosophies indicates that despite their stated philosophical positions, researchers will, in practice, diverge from their theoretical stance and engage in good science and produce good results (Bhaskar 2002: 27-28).

These contradictions necessitate a healthy debate over the current underlying ontological and epistemological positions of ICT for development researchers. Acknowledging the limitations and fallibility of our knowledge is not a reason for inaction, but rather, a call for a constant reflexivity. It is in this spirit of reflexivity that the potential of CR for ICT for development research can be best understood. CR offers a new route to advance theory and research through a reconceptualization of ontology that effectively resolves some contradictory positions taken by positivist or interpretivist researchers.

In terms of empowerment, a realist approach directs the researcher away from definitions based on empirical outcomes towards trying to uncover the changes through time in necessary underlying structural relations that constitute power dynamics of the situation within which agents are situated. Critical realism effectively dissolves debates such as the dystopian/utopian argument over IS and empowerment and provides a new conceptual apparatus that will improve human development research and practice in the future.

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Scaling Of Health Information Systems In India: Challenges And Approaches

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ABSTRACT

This paper addresses the issue of scaling of information systems (IS) in both theoretical and empirical terms. Scaling is an important issue in IS, especially in the contemporary context of globalization, as attempts are ongoing to expand IS in the same context as well as take it into other contexts. Theoretically, an information infrastructure (II) perspective is drawn on to analyze the challenge of scaling, viewing it not merely as a technical problem, but as a socio-technical one involving a heterogeneous network constituted of technology, people, processes, and the institutional context. Empirically, scaling is analyzed based on experiences from an ongoing project to implement health information systems within the Primary Health Care sector in India. The theoretically informed empirical analysis leads to some preliminary insights relating to the questions of "what is being scaled?" and "how is it being scaled?" Some conclusions are drawn on theoretical and practical challenges related to scaling.

1. INTRODUCTION

While in practical terms scale refers to the size or scope of something (for example an information system or a process), scaling concerns the process through which that product or process is taken from one setting and expanded in size and scope within that same setting or/and also incorporated within other settings. In the context of information systems (IS), scale then could refer to the scope of an IS (for example, how many users are served), while scaling could imply the expansion of this system in scope and size (for example, making the system accessible to more users or increasing its functionalities). While a number of contemporary debates in IS research point to the problematic of such an assumption of expansion, the notions of scale and scaling are hardly ever explicitly discussed in IS research.

The notion of scaling is also relevant to contemporary debates around globalization, but again is rarely discussed explicitly. For example, a homogenization perspective argues that globalization is leading to a global convergence of processes and products, implicitly assuming that similar systems can be scaled up i.e. they can be expanded in scope and incorporated in other settings. The opposing perspective of heterogeneity (for example, Appadurai 1996) which argues that different groups will appropriate globalization processes based on their socio-political-historical contexts, sees scaling of systems to be inherently problematic. A "middle ground" on these debates represented by the "glocalization" perspective (Robertson 1992) views the local and global as constituted of and constituting each other. Robertson points out that glocalization finds its origin in the Japanese word *dochakuka,* roughly meaning global localization, because of the Japanese concern for incorporating local consensus which then needs to be scaled up within a global framework. This middle ground view is also reflected in Rolland and Monteiro's (2002) argument for a "pragmatic balance", where we don't strive to scale up systems unproblematically under the assumption of "one size fits all", but instead carefully examine what aspects of the systems are scaleable and what are those that require local customization.

How this pragmatic balance can be achieved, we argue, explicitly requires us to deal with the questions of scale (the level of the balance) and scaling (the process through which this balance is achieved and maintained). This requires an approach that considers, in an inter-connected manner, aspects of technology, people, processes, and the institutional context within which they are embedded. We thus draw upon the sociology of technology literature (Callon & Law 1986; Latour 1987) so as to treat scale not only as a technical issue (such as large scale systems and architecture) or an economic matter (economies of scale or of increasing returns) but as a socio-technical issue. More specifically, we draw upon the Information

Infrastructure perspective (Hanseth and Monteiro 2004, Star and Ruhleder 1996) which specifically concerns large (scale), inter-connected and complex systems.
This paper has two research aims: one, to develop a deeper conceptual understanding of the problem of scale; and two, to apply this understanding to an empirical setting. The empirical basis for our analysis concerns a complex and interconnected system for Primary Health Care (PHC) in India. Problems of scale and scaling are at the heart of the implementation challenge of health information systems in PHCs (Braa et. al., 2004), especially so in India. The rest of this paper is organized as follows. In the following section 2, we develop our theoretical perspective, and in section 3, the case study is presented. Section 4 includes the case analysis drawing upon the theoretical perspective presented in section 2. Finally, some implications of the analysis are presented in section 5.

2. SCALING AND INFORMATION SYSTEMS: SOME THEORETICAL CONSIDERATIONS

The problem of scaling has not received the attention required by IS researchers. Monteiro (1998) provides a quote from the IITA (1995) report to emphasize this point:

> We don't know how to approach scaling as a research problem, other than to build upon experience with the Internet. However, attention to scaling as a research theme is essential and may help in further clarifying infrastructure needs and priorities....It is clear that limited deployment of prototype systems will not work...

Recent research in IS around **information infrastructures (II)** provides a promising perspective to theoretically unpack the issue of scale. Information infrastructures, for example the Internet, represent integrated solutions based on an ongoing fusion of ICTs and processes. Rolland (2002) defines an II as follows:

> A heterogeneous collection of different technologies, components, protocols and applications to support different and varying applications areas and use over time across large geographical distances (Rolland, 2002)

Hanseth and Monteiro (2004) describe IIs to be characterized by three features:

Shared: II is one irreducible unit that is shared by a larger community of users, as a part of the II cannot be reduced and used independently without calling into play the other interconnected parts;
Open: IIs are open in the sense that there are no pre-defined limits to the number of users and stakeholders. Without necessarily implying that everyone and anyone is included in an II, they argue that pre-defined boundaries to IIs cannot be created; and,
Enabling: IIs rather than being designed for particular singular purposes, should be seen as playing a supporting or enabling function for a variety of different application domains.

The II perspective helps to emphasize that the social and technical are not separable and are instead constituted and constitutive of one another. For example, Latour (1999) argues that "airplanes do not fly, airlines do," implying that the artifact of the plane does not fly on its own, but requires a complex and heterogeneous socio-technical network comprising of pilots, navigators, runway staff, air traffic control towers, radars, runways, and flight schedules. Viewed from this perspective, scale is not just a technical or economic issue, but one of scaling a heterogeneous and complex network. However, we seek to go beyond Hanseth and Monteiro's focus on *what an II is* to also examine the socio-technical processes and embedded practices by which the *II is constructed*. The issue of scaling is fundamental to this process.

The ***cultivation approach to II design*** described by various proponents of the II perspective (for example, Bergqvist and Dahlberg, 1999, Ellingsen and Monteiro 2003, Hanseth and Monteiro 2004; Rolland 2002; Hanseth and Aanestad 2003) provides a rich analytical tool to unpack the socio-technical processes and embedded practices that shape the scaling problem. The cultivation approach represents a more conservative approach to design than "construction" which tends to privilege the power of human agency in "selecting, putting together, and arranging a number of objects to form a system" (Dahlbom & Janlert,

1996, p. 6). Instead, cultivation emphasizes the *power of the material*; "the tomatoes themselves must grow, just as the wound itself must heal..." (ibid., p. 6), implying that the "development organization" or "product" being developed should be considered as a unified socio-technical network without privileging one over the other.

The 'power of the material' which the cultivation approach emphasizes relates to the II concepts of the *installed base* and the resulting *lock in* effects (Hanseth and Monteiro 2004). A classical example in this regard is the QWERTY keyboard which represents an installed base to which the current design of computer keyboards are still locked in to. This lock-in effect represents a dilemma in the scaling of an II. Using the example of the Internet, Monteiro (1998) describes how the expansion of the Internet creates new patterns of use, while the infrastructure itself has a strong, conservative influence (arising from a large installed base of routers, users' experience and practices, backbones, hosts, and specifications) which favours a situation of inertia and challenges the scaling up processes. This dilemma cautions against the need to adopt radical (construction kind of) approaches to change and instead favours a smooth and incremental (cultivation kind of) strategy that involves changing one small part at a time while keeping the changes simultaneously aligned with the rest of the network.

A cultivation approach to scaling emphasizes the "improvisational" processes of change, and the potential of what people do in situated action (Suchman 1987), and does not just focus on planned and rational approaches (Ciborra et al., 2000). Design is seen not as a well-defined process with pre-configured start and end states, but as an ongoing process of ecological change. The interconnected nature of the II creates the potential for **"unanticipated effects"** (Walsham, 1993) or "drift" (Ciborra, et al. 2000) which reflects our inability to anticipate events in advance. This helps to emphasize the need to adopt an approach that is in small steps, incremental, and considers flexibility and change. Hanseth and Aanestad (2003) use the bootstrapping metaphor to describe such a design strategy in the analysis of a telemedicine application conceptualized as an II.

A summary of our theoretical perspective is given in Table 1.

Table 1: Summary of theoretical perspective

Concept	Description
Scaling	Scaling is not only about numbers and size (although these are important elements of the problem), which can be achieved through network externalities (where as the value of a technology increases, more users will adopt it) but refers to the processes and embedded practices by which heterogeneous networks around the technology are spread, enhanced, scoped, and enlarged. Thus scaling concerns aspects of geography, software architecture, people, processes, infrastructure, technical support, and political support.
Cultivation approach	A cultivation approach acknowledges the existence of the installed base and the lock in effects and represents an appropriate approach to tackle the challenge of scaling up a complex interconnected system. This approach seeks to address change in an incremental and gradual manner, changing small parts whilst keeping in view alignment with the rest of the network.
Unanticipated effects	In any change effort, there are both anticipated and unanticipated effects. Anticipated effects are best understood in localized conditions, but how these may propogate to the larger network are difficult to pre-determine. Unanticipated effects, arising from the interconnected nature of the information infrastructure and our incomplete knowledge of the whole, are inherent in the problem of scaling, and can contribute to both challenges and opportunities.

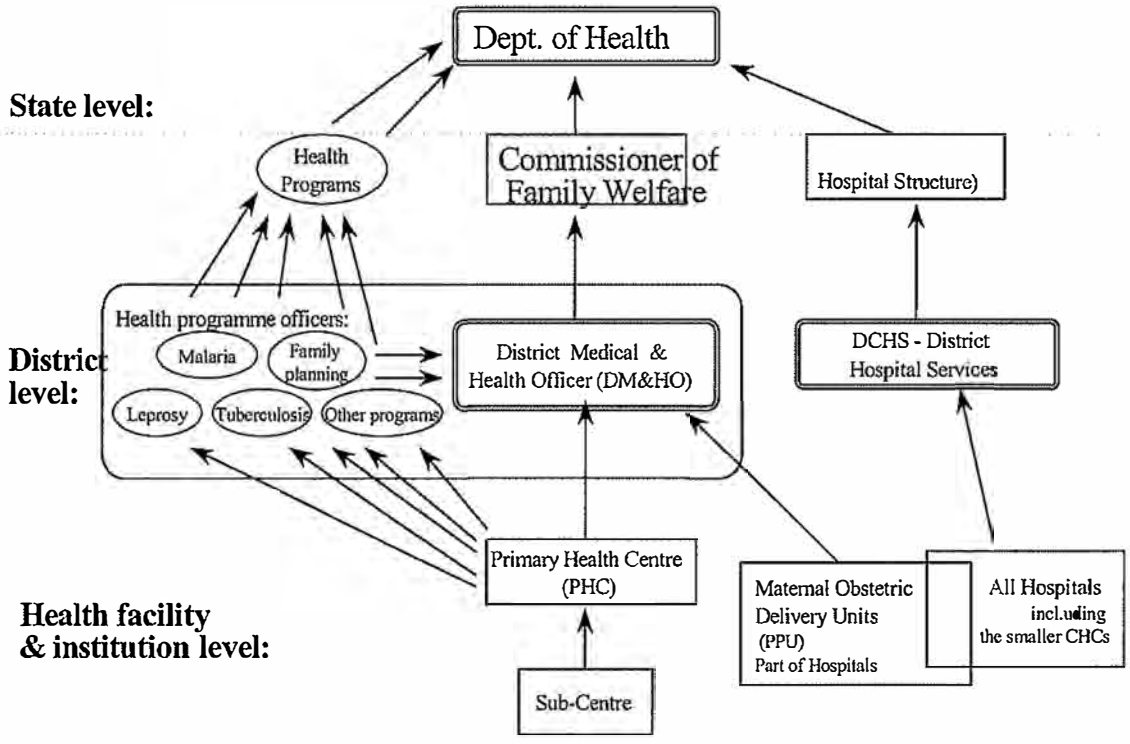
3. CASE STUDY OF HEALTH INFORMATION SYSTEMS IN INDIA

Our empirical material derives from a project relating to the design, development and implementation of the Health Information Systems Project (HISP) (Braa and Hedberg 2002) in Andhra Pradesh (AP), a state in Southern India. AP, by its sheer size and population levels, represents a complex problem of scale, including a population of about 75 million spread over an area of 246793 sq km divided into 23 districts for administrative purposes. A network of 1500 Primary Health Centers (PHCs) and 7500 Sub Centers (SCs) are responsible for catering to the health care needs of the population. The case study is described in three phases, reflecting three different and increasing levels of scale: the Kuppam pilot; the Madnapallli expansion; and the state wide expansion.

3.1 The Kuppam pilot phase: Dec 2000 to Sept 2002

After negotiating access from the state and the district levels in 2000, we commenced our field work in Chittoor District which has a population of about 3.75 million and 84 PHCs. Initially, we conducted a situation analysis to firstly understand the organisational structure and patterns of health information flows, and secondly, to design a Minimum Data Set (MDS) of items that can be used by the PHCs and SCs. This analysis was done through field work conducted over a year in 2001 when we visited a number of the health facilities and had discussions with various health staff including field level workers, administrative staff and medical doctors. We also made an in-depth study of various report formats, copies of registers and diaries used for data collection. Two outputs resulted from this study. The first concerned the design of a MDS which sought to rationalize the data elements being collected by the PHCs and SCs by identifying the minimum set of common items. The second output concerned our conceptualization of the structure of the health information flows as depicted in Figure 1:

Figure 1: Overview of health information flows



As Figure 1 illustrates, there are a number of structural issues that shape the information flows. Firstly, the fragmented and vertical data flow which results in data redundancies and poor integration of information at the district level that is supposed to serve as the 'hub' of this information network. Secondly, there is a steady aggregation that takes place as the data moves up the hierarchy, which systematically masks the facility level data, making it difficult to analyse the situation at the local level. Thirdly, the arrows are primarily one-way (top to bottom) reflecting limited feedback of information to support the local levels. Fourthly, the separation between the hospital and PHC sector represents an obstacle to unified management of health services at the district and sub-district levels.

In September 2001, we presented the results of our analysis to the Commissioner of Family Welfare (CFW) who is the overall head of the health department in the state, and also to the Chief Minister (CM) who is the highest political figure in the state. The CFW, who was interested in supporting an alternative World Bank-supported project, was not very forthcoming towards our efforts. We tried to address the CFW's resistance by leveraging on our support from the CM's office. We also made a presentation to the CM in the presence of other senior officials from the health and IT departments. The CM was very appreciative of our efforts, and sanctioned 12 computers for implementing in the 9 PHCs in Kuppam constituency[1] (plus three for the district office). Out of the 9 PHCs, three of the computers had to be subsequently withdrawn because of infrastructure problems related to the lack of a proper building, lack of staff, or security concerns. We thus conducted our implementation in 6 PHCs. The initial months of the project were severely impeded by poor infrastructure and poor technical support. The computers or the power supply constantly blew up due to power fluctuations, caused by the absence of earthing wires. This problem was further magnified by poor technical support since the vendors were reluctant to travel to the distant rural areas, especially after having received their payment for the computer supply. Disruption in power supplies, sometimes up to 10 to 12 hours a day, further impeded the progress of the project.

To deal with the local challenges, we developed a partnership with a local computer company to provide training and local support to the PHCs. In the first three months, this company provided full time support in the 6 PHCs in addition to conducting a monthly combined workshop for staff from all the 9 PHCs in a central location. After 3 months, one trainer was made responsible for supporting all the 9 PHCs for an additional 9 months. The process of training was accompanied with the task of customizing the software to local needs, including the implementation of the MDS; populating the database; and automating of the routine reports required to be sent monthly from the PHC to the state. The ongoing feedback received by us on the prototype systems developed, individually from the health staff and also through the combined workshops, helped to continually improve our systems, especially the datasets and report formats.

In September 2002, an official from the CFW office along with some district officials visited Kuppam to evaluate the project. They visited some of the PHCs and saw how data entry work was being carried out by the health staff, who were also asked to explain various features in the software relating to exporting data, making graphs and charts, and generating reports. Ten days after the evaluation, we were informed that a Government Order had been sanctioned to extend our project to the Madanapally revenue division that included 46 PHCs, and a Memoradum of Understanding (MoU) was subsequently signed between the CFW and HISP. Through this MoU, the Government sanctioned US$ 35,000 for the purchase of computers, trainer salaries, and to support development costs.

3.2 The Madnapallli phase: expanding to 46 PHCs

The MoU mandated the expansion of the HISP processes to the 46 PHCs of Madnapallli revenue division (which also included the 9 PHCs of Kuppam) within a relatively short time of 6 months. This presented a significant challenge of scale at least at two levels. Firstly, the HISP team had to be scaled up from the two full time members to 9, which posed challenges of getting them up to speed both with the HISP software and the workings of the PHC. Secondly, it was necessary to expand the size and scale of the operations, including the number of PHCs covered, training to a larger number of health staff, and coping with the larger distances between the PHCs.

Learning from the Kuppam experience, we attempted to address the scale challenge first in structural terms. Realizing that many of the PHCs did not have adequate capacity and infrastructure to host the computer,

we adopted a "cluster strategy" whereby a computer would not be placed in every PHC, but in a "hub" PHC that would serve a cluster of 4-5 geographically proximate PHCs. The hubs were located in what is called as a "24 hour PHC" which typically had relatively stable infrastructure (for example, power supply), and a secure room in which the computer could be placed. The HISP trainer was based in this hub, and he/she established schedules whereby the health staff from the cluster would come for training, to do data entry, and to generate monthly reports. To address the challenges of power fluctuations and the damages caused by it, we conducted an audit of the electrical wiring before installing the computer, and replaced the earthing where required. We also shifted from Laserjet to dot matrix printers as they required less support, and fewer consumables. We deliberately hired a hardware engineer amongst the 8 new recruits, to strengthen the provision of hardware support and to help develop local competence.

This cluster strategy generally worked although some of staff from the non-hub PHCs protested against not having computers themselves. Within 6 months we achieved similar levels of implementation (training, database population, report generation) as we had done in Kuppam in about double the time. Many of the PHCs started to generate their own monthly reports using the software, and presented them to the district office instead of the earlier manually generated reports. In the meanwhile, the project started to face certain tensions arising from the State's efforts to implement another software called FHIMS[2] (Family Health Information Monitoring System). As a part of this project, in September 2003, computers were installed in all the PHCs in the state (about 1500), and the FHIMS software was expected to be installed within the next 6 months. The health workers started to get conflicting signals about whether they should continue with HISP or wait for FHIMS. In some cases, where there was a good personal rapport between the HISP trainers and the PHC staff, the HISP processes continued; while in others, the momentum started to be lost. Also, recognizing the danger of being thrown out due to FHIMS, we realized the need for a strategy of integration rather than competition, and we provided a proposal to the CFW for this. The CFW was not positive to this proposal as she wanted to clear the way for an unambiguous state wide FHIMS implementation. However, with much persuasion and support from the Chief Minister's office, she agreed to give us a contract to implement a new web-based system for the monitoring of infant and maternal mortality deaths in all the 23 districts in the state. This project was seen as being relatively non-interfering with the FHIMS implementation, and was also to take place at the district rather than the PHC level (where FHIMS was currently focused). However, along with this project, we also negotiated with the CFW to develop a district level data base for all the 23 districts, and to link the routine data to maps using Geographical Information Systems.

3.3 State level expansion: across 23 districts

In terms of scale, the move from Madnapallli to all 23 districts in the State represented a quantum leap as it involved a move from 49 to 1500 PHCs. However, the focus was not on individual PHCs, but on the district capital where data from all the PHCs in the district were consolidated. In effect, we had to scale up from 12 hubs to 23 districts locations, but representing a vast geographical area. As the allocated time for the project was very limited (only 4 months), and also the budget, we hired only 3 new trainers and each trainer was allocated two districts, with responsibility to split time equally between them.

This phase involved a dramatic expansion in both geographical scope and technical complexity. The limits of the Access database in the existing software became clearly evident, and we needed to port the whole database to MySQL. In the district, the data was still entered into the existing software, then an export file was created in text format in each district, which was then sent by email to the State capital where our lead developer imported the emailed file into the MySQL database using a utility developed for this purpose. A server space was rented in Singapore, and the state database was web enabled using DotNet thus providing the functionality for users to view state wide reports. Once the data for all the districts for one year was entered, the database size became 634 MB (after compacting) and included more than 3.5 million records. The size of the database made the system access very slow, a problem magnified by the relatively slow connectivity that was available to us (32Kbps).

While the technical systems were relatively successfully scaled up in a short period of 4 months, the scaling has been far more complex institutionally, for example in getting the State authorities to accept and use the systems. This complexity was further magnified by the announcement of state elections in January. Firstly

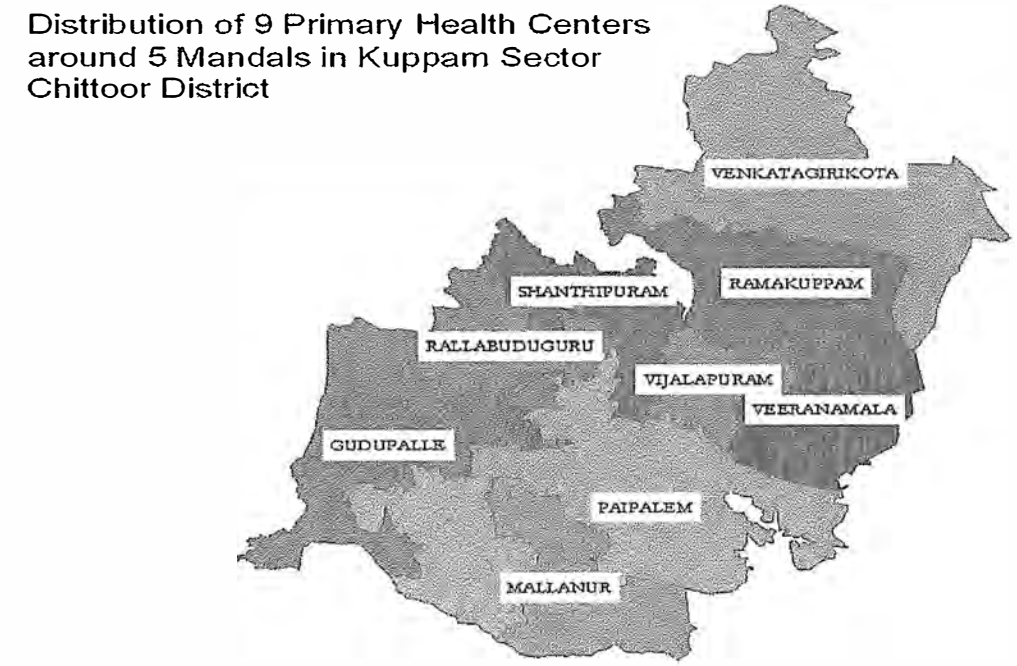
our project was scaled down from 6 to 4 months, and secondly, the uncertainty of the elections made the officers feel ambiguous about their own futures, contributing to their lukewarm interest towards the project. In May 2004, the election results were announced and the ruling party was voted out of power, with the CFW being moved to another department. As a result of these changes, the systems developed are without any owner at the time of writing, although they are technically scaled up to cater to the needs of the entire state. We are now in the process of trying to present ourselves and the system to the new Commissioner who still requires time to orient himself with the various initiatives ongoing in his department before taking any decision.

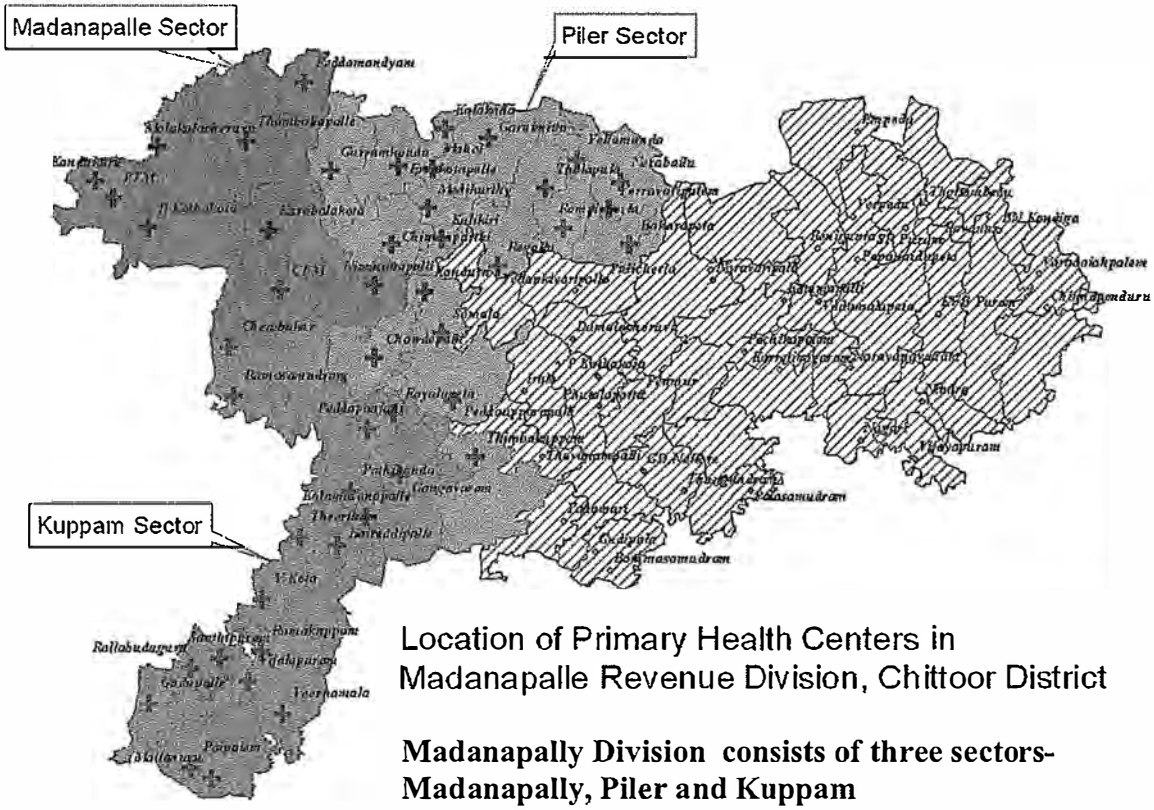
4. CASE ANALYSIS

The case analysis is presented in this section around two key questions: what is being scaled?; and, how is it being scaled?

4.1 What is being scaled?

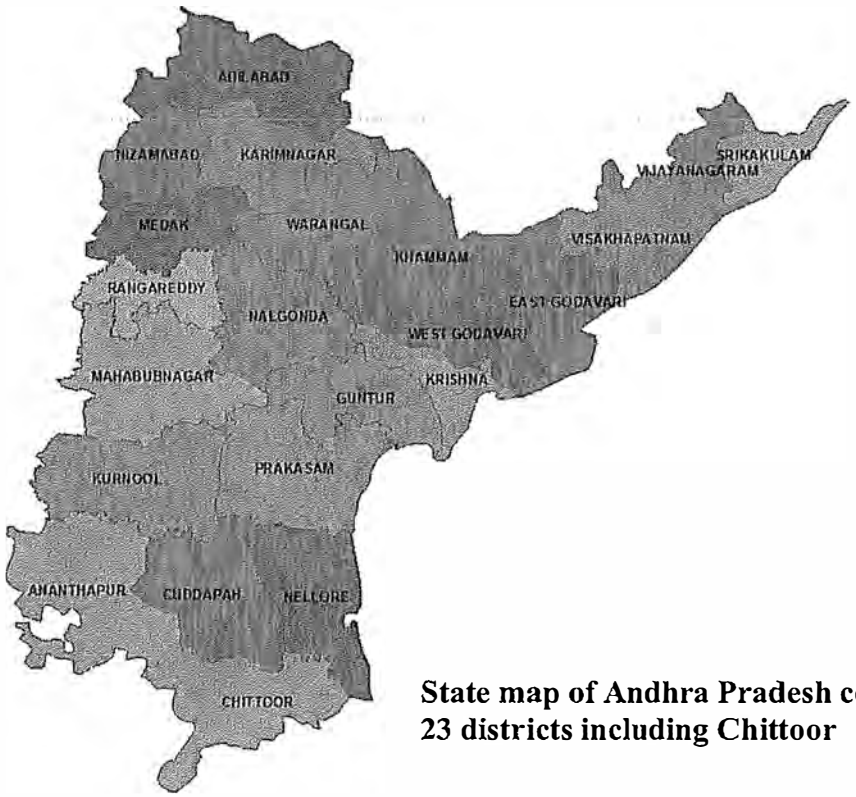
The three stages of the case represent three increasing levels of scale of multiple and inter-connected aspects. There is the increasing *geographical* scope and *numbers* of clinics from 9 PHCs located in about 2000 sq km (Kuppam) to 46 PHCs over 8000 sq km (Madnapallli) to 1500 PHCs over 15000 sq. km. The increasing geographical scope of the operations was, paradoxically, accompanied with a reducing amount of time given to us (1 year to 6 months to 4 months in the three phases respectively). In the three maps below, we depict the three respective levels of geographical scope: Kuppam; Madnapallli, and the whole state.





Location of Primary Health Centers in Madanapalle Revenue Division, Chittoor District

Madanapally Division consists of three sectors- Madanapally, Piler and Kuppam



State map of Andhra Pradesh containing 23 districts including Chittoor

The increase in scope was accompanied also with a magnification of the *technical* complexity of the systems. From the standalone report generation applications in Kuppam, we were required to integrate with FHIMS in Madnapallli. In the state, the need was to develop a web based application hosting the state database, which required a move from Access to MySQL, and hosting the system on a Singapore based server. The increasing size of the database and the need for Internet access placed additional demands on network connectivity and reliable power supply. To deal with the increasing scale, there was the need for the *implementation team* to be itself scaled up both in terms of numbers of people and also skill levels. For example, to deal with the hardware problems in Madnapallli, we had to hire people with hardware maintenance skills, and in the State we needed people with web development and MySQL capabilities. All the members, in addition, needed to be oriented to the HISP approach, which emphasizes a social science perspective to implementation. Being sensitive to people and organizational issues is not a quality that comes naturally to computer science graduates from Indian institutions that typically emphasize technical skills.

As the case progressed, we needed also to confront increasing *political* complexities. Whereas in Kuppam we could manage in a relatively standalone manner with support from the CM's office, in Madnapallli we had to also deal with other divisions who had their own functionaries. In the State, we had to engage with all the state authorities, and to ensure that our work was in line with the politics of the state (for example, the interest of the State to promote the alternative FHIMS system), which also required us to form alliances with other agencies, for example the technical developers of the FHIMS system. The complexity was magnified by institutional factors such as the movement of functionaries (for example, in Chittoor we had to deal with 4 different heads of the health department in 3 years), and political developments such as the announcement of elections, the results of which led to the change of the ruling party and with it the transfer of the senior health department functionaries. This required the renegotiation of alliances, an essentially political process.

So, the answer to the question of "what is being scaled?" is not simple or a uni-dimensional listing of factors. It can be described as a scaling up of *complexity*, best conceptualized or represented as a heterogeneous network comprising of geography, numbers, technical systems, data and databases, trainers, and the socio-technical practices such as political negotiations that try to hang the network together.

4.2 How is it being scaled?

Our approach to scaling was multi-faceted, some elements planned, some unplanned, and others emerging from the changing political and institutional circumstances which both opened up new opportunities and closed off others. For example, the current change of guard in the Commissioner of Family Welfare has opened up the opportunity of the health department reconsidering the alternative we offer as compared to FHIMS. However, the political changes have also resulted in the movement of a champion of our project from the Chief Minister's office to another one.

Our approach can be best described as one of cultivation, as described earlier, which involved small incremental steps, sensitivity to the existing installed base, and being reflexive in dealing with the rapidly changing political and institutional conditions. For example, we had planned to start small, within a limited geographical setting, to firstly try and understand the health system and to build the prototypes from the bottom up. Starting in the 9 PHCs in Kuppam was in line with this thinking. However, the next step to expand to Madnapallli division was relatively unplanned and defined primarily by the wishes of the CFW. There were also instances of the planned and unplanned working together. For example, the requirement of placing the systems for the infant and maternal mortality monitoring in all the 23 districts was rather unplanned and arising from the wishes of the CFW. However, given this opportunity, we made a conscious plan to also place the DHIS software in all the 23 districts simultaneously.

The installed base in our case is represented by the existing data items and report formats. So, our first step was to adopt a participatory approach to see how the redundancies in the data items could be reduced and a MDS developed. This process was in the interest of the health workers who perceived this process would help reduce their manual work, and they thus actively supported us. After this process, we proceeded to

automate all the existing reports, making them exactly in the same format as the paper ones. This helped to allay fears that the reports would be changed (which cannot be done easily in a hierarchical structure such as India), and again was supported by the staff as it reduced the time spent by them every month in making the reports manually on multiple paper forms. The definition of items in the MDS, as they were standardized, also helped to take the systems relatively unproblematically to other PHCs.

To deal with the challenge of increasing scale, in Madnapallli we adopted a cluster approach, thus enabling 12 computer sites to meet the needs of 46 PHCs. In the state, 23 sites (of district head offices) were chosen to cater to the data needs of 1500 PHCs. While we lost some detail in this process (for example, the SC level data in the district database), we gained in being able to provide a state wide coverage which appealed to the policy makers in the state. Placing the system on the web also helped to increase visibility and gain political legitimacy of the state authorities who wanted to have access to the latest technology (the Web in this case). Similarly, the integration of the routine data to maps helped us to both provide visibility to a larger geographical area, and also catered to the political needs of latest technologies. Scaling problems arising from technical support were tackled by changing the kinds of printers, and also by hiring a hardware engineer so as to reduce external dependence. Needs for increased training were dealt with to some degree by preparing manuals that the trainers could self-study to get up to speed with the basics of the software, and also use for conducting training sessions for larger groups of people.

While we started with a bottom-up and cultivation approach, this was soon complemented or integrated with a top-down strategy of placing the systems only in districts and the state capital. The bottom-up approach was necessary for us to understand the local-level needs and to develop relevant and robust applications. However, this in itself would have been inadequate without the top-down approach which helped us to scale up and thus provide a full coverage of the state, gaining a greater level of political legitimacy and support. We argue that an integration of both approaches is necessary for successful scaling

5. CONCLUSIONS: PRACTICAL AND THEORETICAL CHALLENGES OF SCALING

Practically, scaling up of health information systems in PHCs is a very complex endeavor for at least three reasons. One, there is the unique problem of "*all or nothing*." This implies that systems are practically useless for the health department unless the coverage of the whole state is obtained. For example, to be able to compute the immunization coverage of the state, data is required from all the reporting facilities collected in similar formats, and using the same business logic for the calculation of the indicator. So, if we had continued to work in Kuppam alone, our systems would have been of little use as they would not have been visible or relevant for the CFW. A second problematic condition for scaling concerns the *political nature* arising from the confluence of interests of the donors, vendors, the political leaders, and the bureaucrats. The PHC sector thus represents a "battlefield" comprising of this multiplicity of interests and competition for large sums of money coming primarily through donor agencies. This political nature cautions against simplistic scaling approaches based on economic principles or numbers drawing upon traditional principles of network externalities. A third condition concerns the continuous state of *change and instability* that constitutes this sector. This instability arises from the frequent political changes, revisions in technological demands, and also changes in public health needs. For example, the escalation of the current HIV/AIDS crisis is creating demands for new health initiatives which place pressure for different kinds of data and reporting systems. Instability and change are thus inherent, and they have direct implications on the scaling process.

Theoretically, unpacking the complexity of scale and scaling opens up a range of challenging questions. There are a variety of dilemmas associated with scaling, relating for example to standardization and local customization; top down and cultivation approaches; treating people as "whole humans" versus as statistics; appropriate versus complex technological solutions; and the "all or nothing" challenge particular to the PHC sector. While in this paper, we have alluded to some of these dilemmas, they need to be more carefully unpacked, theorized, and insights developed through empirical analysis in varied settings.

Our work to date helps us to reflect upon some of the implications for human resources capacity development, which is the theme of this conference. A key implication to consider is that people involved in implementation should not only be focused in technical terms, but should also have a sound

understanding of the needs for scaling up of systems, and how this process is not only about the software architecture (which of course is crucial), but also about the escalation of complexity. This involves considering institutional issues, politics, and the growing of the team itself. The team should also have the ability to seize opportunities that may arise due to the occurrence of unplanned events, and use it to their advantage to effectively address the scaling challenges.

NOTES

[1] An electoral constituency represents a geographical area for electing a member to the state assembly. Kuppam is one such constituency within Chittoor district from which the CM had been elected in the past. This geographical area consisted of 9 PHCs where we were asked to implement our initiative.

[2] FHIMS is a software that enables the collection of data based on individual names of patients as contrasted with the HISP software that deals with aggregated data for facility based (PHC and SC) reports.

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Offshore IT Outsourcing To Emerging Economies – Analysis of Readiness Vs. Attractivess

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ABSTRACT

This paper investigates offshore IT outsourcing readiness and attractiveness to economically emerging countries. Offshore of IT software development to low cost development regions is gaining increased popularity in the US and Western Europe. Previous researches have addressed key success factors. Through a literature review 32 critical success factors were identified, that were divided into five factor groups. The first two factor groups (technical infrastructure, and business infrastructure) were identified to determine readiness and the other three factor groups (people factors, societal interface, and regulatory interface) were identified to determine attractiveness. One major finding was that cost, an important attractive factor, is not the most important factor when US companies are selecting an offshore IT location. The paper concludes with a discussion on the implications of these findings to outsourcers in economically emerging countries.

Keywords: Offshore IT Outsourcing, Success Factors, Economically Emerging Countries

INTRODUCTION

Offshore outsourcing is the transference of an Information Technology (IT) function, from a client company to a supplier organization located outside the borders of the client company's country. It is a commonly used strategy among leading companies in the United States, US, and Western Europe. Companies typically invest in offshore outsourcing with the expectation of lower costs, economies of scale, access to specialized resources, and/or new business ventures (McFarland and Nolan, 1995, and Aubert, et. al., 1998). An offshore outsourcer in a location is considered ready when the required external technical infrastructure and internal technical skills are in place to deliver the expected IT services and products. An offshore outsourcer in a location is considered attractive when the supporting resources are available and enforced to make sure that offshore outsourcers can deliver the expected quality IT services and products on time and on schedule.

The late 1990s saw an increase in the outsourcing of software development, and in particular, offshore software development. Rajkumar and Mani (2001) point out that Year 2000, and converting systems to accommodate the European change in currency to the Euro have stressed organizations' ability to keep up with necessary development leading to outsourcing more development projects to offshore developers. Contributing to the increase in offshore development are advances in telecommunications technology and personal computers that have increased the ability of companies outside of the United States to provide development services. Currently, the high demand for e-business and Internet based solutions is continuing the drive for offshore development.

Traditional offshore software development was primarily application development (Carmel and Agarwal 2002). These applications tend to be highly structured requiring little or no changes to the requirement specifications. These projects require less interaction and project management from the client. They are ideal for outsourcing as deliverables and bids are understandable and predictable and risks are better understood. Current offshore development includes e-business and web application development, and "follow-the-sun" or "round the clock" application development. These projects tend to be less structured in

nature and need more client contact and project management than traditional offshore development projects. They are less ideal for outsourcing as deliverables, costs, and risks are less predictable.

Offshore software development offers an opportunity to significantly reduce the cost of application development. However, given the change in the types of projects being outsourced, there is a need for client organizations to assess the likelihood of outsourcer companies to successfully complete the project. Conversely, given the ease of starting a company that supplies development services, it is important for startups companies in emerging economies to understand what it takes to be a ready and attractive from the clients' perspective. Rajkumar and Mani, (2001) note that the major player in offshore software development outsourcing is India (with approximately $6 billion in software and services in 2000, Smetannikov, 2001).

Murray and Adelakun (2004) identified a set of critical success factors that outsourcing participants need to meet to be successful and performs an exploratory study to determine what are the most critical. Based on this success factors identified by Murray and Adelakun (2004) this paper analyze when a location is deem ready versus attractive. The goal is to identify a small set of group of factors that organizations in emerging countries should concentrate on to be a successful IT outsourcer. Organization providing offshore outsourcing services to the United States, are expected to have the fewest resources will benefit the most from this study.

Additionally, this study is expected to assist potential client organizations in how to look at and assess offshore companies. Many potential client organizations do not have processes for looking at these potential sources of system development and the readiness and attractiveness factor groups presented in this paper should provide a basis for them to analyze potential providers. To do this we propose three research questions:

1. What are the critical success factors for offshore outsourcers in economically emerging countries?
    a. Which factors makes an offshore outsourcer ready?
    b. Which factors makes an offshore outsourcer attractive?
2. What critical success factors should an offshore outsourcer in a specific location focuses on?

The next section describes how the critical success factors were determined

METHODOLOGY

This is an in-depth theoretical analysis and sub classification of critical success factors into readiness and attractiveness categories. Through a literature review 32 critical success factors were identified, that were divided into five factor groups. The first two factor groups (technical infrastructure, and business infrastructure) were identified to determine readiness and the other three factor groups (people factors, societal interface, and regulatory interface) were identified to determine attractiveness.

LITERATURE REVIEW

This literature review summarizes the literature with respect to offshore development success factors.

Offshore Development Success Factors

As the market for offshore IT outsourcing grows and companies are formed to meet the demand, it is critical to understand what factors will contribute to their success. Studies that identify these factors are few and are summarized below. Table 1 at the end of this section provides a summary of identified critical success factors.

Rajkumar and Mani (2001) discuss why India's software developers are successful. Reasons for this success are an abundant supply of highly educated but low paid software engineers, English is the language of education and business in India, and the Indian government's development of infrastructure and tax and financial incentives. They further discuss the need for the business to be organized to support the client through interfacing, project management, and contract management. Ultimately they list four categories of success factors: Management, Customer, Project, and Staff. The management factor focuses on the leadership of an organization. Managers are expected to guide the organization and ensure adequate resources are allocated through business plans and strategies. Also, management must ensure that facilities and staff are developed to support the target market. The customer factor focuses on developing a relationship with the client. It includes setting up communications with the client, visiting the client, learning from the client, and integrating practices when feasible with the client. The key is to understand the client so that the developer can add value and develop a long-term relationship. The project factor focuses on project management. The software developer must be able to estimate and manage the project. Care has to be taken to ensure project scope is clearly understood as well as who is authorized to change it. Two key concerns are avoiding research and development projects and ensuring that functional test requirements are clearly communicated by the client. The staff factor focuses on hiring and retaining technical talent. Career paths must be established and care taken to ensure that management is meeting the needs of their staff. Support for travel to client sites in the form of funds and visa support. Finally, flexibility in hiring needs to be established to allow for clients who wish to hire developers of their systems.

Smetannikov (2001) discusses problems facing Russian software developers rather than success factors. Chief among these problems are travel difficulties, cultural differences, real and perceived, between Russian and American programmers, and an unstable Russian business climate. Russian companies are impatient to get business, they feel it is only a matter of time before they will be credible competitors with India.

Raval (1999) discusses his secrets of successful offshore software development from the viewpoint of the client. These secrets or factors are having a strategy for offshore development, understanding the countries you are outsourcing to and the risk associated with outsourcing, preparing the organization and the offshore developer to work with each other, delegating offshore administration to local expertise, and not letting cultural and language issues affect the project.

Kumar and Palvia (2002) discuss the key influence factors and issues affecting the management of global IT outsourcing based on a survey of outsource managers from client organizations. Some of their key findings are that the longevity of the outsource relationship directly impacts the scope of work given to the outsource provider; competitive pricing and similarities in corporate culture were the most common reasons for selecting an outsourcer; outsourcers normally had better technical skills than the client; and strategic outsourcing normally had formal communication channels.

Jain and Song (2002) reviewed the literature and generated a conceptual model that addressed reasons for selecting a offshore development location. Some key attributes include IT managers having cross cultural communication skills, size of the outsourcer, skills and wages of outsourcer personnel, ability of the outsourcer country to train and educate workers, intellectual property protection, governmental regulations, exchange rates, tax rates, political stability, and telecommunications infrastructure.

Jennex, Amoroso, and Adelakun (2003), performed case studies on two micro-sized startup, offshore software development organizations. One organization was in Italy and the other was in Ukraine. Key attributes identified as contributing to success or failure include pricing of services, telecommunications infrastructure, availability of current hardware and software, technical skills of workers, project management and controls, business organization and processes, client interface, time difference and travel issues, legal representation, tax and other regulations, and payment processes.

Jennex and Adelakun (2003) investigated key factors affecting the success of small to medium organizations providing offshore software development, usually to companies in the United States. They identified five success factor groups (people factors, technical infrastructure, client interface, business

infrastructure, and regulatory interface). The critical success factors were assessed for importance by surveying individuals in organizations that outsource system development or that provide system development services. The survey found that the critical success factors of workers' skills, client knowledge, and trust in the client-outsourcer relationship, telecommunications, and intellectual property protection are the most critical to the success of offshore software development outsourcers. Jennex and Adelakun (2003) concluded that cost was not the most critical success factor.

Palvia and Vemuri (2002) discuss obstacles and critical success factors for global E-commerce. Obstacles include overseas shipping problems due to complexities and issues with customs, tariffs, currency exchange, and shipping. Other key obstacles include a lack of trust between transacting parties, lack of access to computers and the Internet, and limited electronic payment capability. Factors that can be applied to offshore outsourcers are maintaining a personal touch; recognizing culture, local regulations, pricing constraints, and language; minimizing connection times due to less reliable connections in developing countries; and fostering trusting relationships between clients and outsourcers.

Gattiker, et. al. (2000) discusses the importance of economic and cultural factors. Global economic factors include the cost of connecting. Global cultural factors include differences in work habits and language. It has been found that simply translating documents does not ensure the translation will contain the same cultural meaning as the original. Factors that can be applied to offshore outsourcers are telecommunication infrastructure and cost, cultural understanding, and language issues.

Sairamesh (2002) discusses the importance of contracts. Freeman (2001) discusses contract and other legal risks including intellectual property protection, conflict and dispute resolution, fulfillment of contracts, use of patented business processes, and trademark and copyright issues. The success factor from these risks is having legal consultation available for review of documents, processes, and contracts.

Castelluccio (2000) lists fourteen critical success factors of which having adequate business processes and maintaining account information and a relationship profile are relevant to offshore outsourcers. Turban, et. al. (2002) discuss critical success factors for SMEs. SME critical success factors relevant to offshore outsourcers are: providing niche or specialty information development, having a low capital investment, using secure electronic payments (when using electronic payments), and flexible payment methods. Also, the business should follow basic good business principles such as marketing properly, pricing correctly, anticipating cash flow, monitoring competition/technology/marketplace changes, and developing good internal communications.

Several studies have been done looking at basic infrastructure requirements in developing countries that are relevant to offshore outsourcers. Mukti (2000) identified issues in Malaysia with security concerns, payment, Internet access, and technical skills of workers. Cloete and Courtney (2002) discussed SMEs in South Africa. They found issues associated with factors within the organization such as a lack of access to computers, software, other hardware, and telecommunications at a reasonable cost; concerns with security and legal issues; and low knowledge level of management and employees as inhibitors to Internet based business. Dedrick and Kraemer (2001) looked at China and found that although there is considerable interest there are also significant barriers to establishing Internet based ventures. These include limited diffusion of computers, high cost of Internet access, lack of online payment processes, limited availability of banking services, and uncertain taxation rules. Government policies promoting IT and E-commerce and attacking software and intellectual property piracy were noted as encouraging Internet based ventures while regulation in the areas of international contracts, foreign participation, and digital signatures and encryption is needed to continue this trend.

Chepaitis (2002) looked at the information environment in Russia and found that the information environment can be an impediment to the development of e-commerce in emerging economies. Many developing countries do not have a culture of sharing data. The ability to pool data for statistical analyses

is necessary for many business processes and organizations. The absence of shared data can result in a lack of effective information systems due to the lack of reliable and consolidated marketing, customer, and economic data. This also usually results in low data quality and trust in the data that is available. Twelve factors were identified that affect the information environment in an emerging economy. The factors focus on the business culture of the economy and will limit the emergence and scope of e-commerce in these economies. The factors include unsuccessful/ intrusive government planning and regulation; formal barriers to entry and dictated pricing in distribution and supply; informal entrepreneurship such as black markets and barter; ineffective methods for managerial accounting; political fear and widespread avoidance of information sharing; unstable currency, immature financial regulations, and a lack of financial services; a reluctance to divulge information without compensation or reciprocity; proprietary attitudes towards data ownership; rigid, hierarchical management styles with a reluctance to share information or empower employees; communication behaviors that rely on oral tradition or more than one language; and an emphasis on price and availability to the exclusion of quality.

Sukovskis (2002) describes the IT sector in Latvia. Factors supporting the development of outsource ventures in Latvia include government support for regulation encouraging E-commerce, a fairly well developed telecommunications infrastructure available for a price, and a growing cadre of IT professionals. Inhibitors to outsourcers are modern hardware and software being available but expensive; limited availability of investment capital; and the small number of available IT professionals (the demand for IT professionals is greater than the supply).

OFFSHORE OUTSOURCING CRITICAL SUCCESS FACTORS

The first research question asks what the critical success factors are for offshore outsourcers in economically emerging countries. This question was answered by the identification of a list of critical success factor groups with specific critical success factors generated from the literature review. Table 1 lists the critical success factor groups: People factors, Technical Infrastructure, Client Interface, Business Infrastructure, and Regulatory Interface; with their component critical success factors and their citation sources. One critical success factors listed in the literature is not used. Kumar and Palavia (2002) discuss the importance of longevity as a factor influencing the scope and quantity of work given to an outsourcer. This critical success factor is not used in the business infrastructure or client interface groups as it is not relevant to a startup company or potential offshore location. It is recommended that existing companies consider this critical success factor although this paper presents no analysis with regard to their importance.

The critical success factors are grouped into five naturally coherent groups for two reasons. The first is that assessing 32 critical success factors as a whole is difficult. It was determined that segmenting them into naturally coherent groups would make it easier for potential survey respondents to assess them for completeness as instead of determining if any should be added to the total list they will be asked to determine if any should be added to each group's list. The second reason is that the influence of the critical success factors on the participants of an outsourcing relationship can more readily be expressed and understood in model form when expressed as groups. Using groups reduces the numbers of factors that must be modeled and makes the model simpler to visualize. The resulting model is discussed in the following paragraphs.

Table 1, Reference Sources for Critical Success Factors
(Modified from: Jennex and Adelakun 2003).

Group	**ID**	***Critical Success Factor***	***Source Citing Critical Success Factor***
People Factors	PF1	Worker General Knowledge Skills	Cloete and Courtney (2002); Jain and Song (2002), Rajkumar and Mani (2001), Sukovskis (2002)

	PF2	Worker Language Skills	Chepaitis (2002); Gattiker (2000); Jain and Song (2002), Palvia and Vemuri (2002); Rajkumar and Mani (2001), Raval (1999)
	PF3	Worker Cultural Awareness	Chepaitis (2002); Gattiker (2000), Palvia and Vemuri (2002), Raval (1999), Smetannikov (2001)
	PF4	Project Management People Skills	Chepaitis (2002); Cloete and Courtney (2002); Gattiker (2000); Palvia and Vemuri (2002), Rajkumar and Mani (2001),
	PF5	Worker Cost	Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Kumar and Palavia (2002), Rajkumar and Mani (2001),
Technical Infra-structure	TI1	Telecommunications infrastructure	Cloete and Courtney (2002); Dedrick and Kraemer (2001); Gattiker (2000);Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri (2002); Mukti (2000); Sukovskis (2002)
	TI2	Up to date PCs, other computer HW/SW	Cloete and Courtney (2002); Dedrick and Kraemer (2001); Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri (2002); Sukovskis (2002)
	TI3	Worker technical skills	Cloete and Courtney (2002); Dedrick and Kraemer (2001); Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Kumar and Palavia (2002), Mukti (2000), Palvia and Vemuri (2002), Sairamesh (2002); Sukovskis (2002); Turban et. al. (2002).
	TI4	SW project management	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001),
	TI5	SW control processes	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001),
Client Interface	CI1	Client knowledgeable	Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Kumar and Palavia (2002),
	CI2	Trust	Kumar and Palavia (2002), Palvia and Vemuri (2002)
	CI3	Client language skills	Chepaitis (2002); Gattiker (2000); Jain and Song (2002), Palvia and Vemuri (2002)
	CI4	Problem resolution process	Jennex, Amoroso, and Adelakun (2003), Kumar and Palavia (2002), Rajkumar and Mani (2001)
	CI5	Time differences	Jennex, Amoroso, and Adelakun (2003)
	CI6	Client/outsourcer travel	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001), Smetannikov (2001)
Group	**ID**	***Critical Success Factor***	***Source Citing Critical Success Factor***
Business Infra-structure	BI1	Business Plan	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001), Raval (1999)
	BI2	Business Organization	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001)
	BI3	Business Processes	Castelluccio (2000); Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri (2002),
	BI4	Cost/Cash Control Process	Castelluccio (2000); Dedrick and Kraemer (2001); Turban et. al. (2002)
	BI5	Advertising	Palvia and Vemuri (2002); Turban, et. al. (2002)
	BI6	Client contact methods	Castelluccio (2000); Jennex, Amoroso, and Adelakun (2003)
	BI7	Payment Processes	Dedrick and Kraemer (2001); Jennex, Amoroso, and Adelakun (2003), Mukti (2000), Palvia and Vemuri (2002); Turban et. al. (2002)
	BI8	Legal Representation	Cloete and Courtney (2002); Dedrick and Kraemer (2001); Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Sairamesh (2002);
	BI9	Size	Jain and Song (2002)

Regulatory Interface	RI1	Intellectual Property Protection	Jain and Song (2002), Palvia and Vemuri (2002); Rajkumar and Mani (2001), Turban et. al. (2002)
	RI2	Tax laws	Dedrick and Kraemer (2001); Jain and Song (2002), Rajkumar and Mani (2001),
	RI3	Banking/Wire Transfer laws	Dedrick and Kraemer (2001); Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri; Rajkumar and Mani (2001), Sukovskis (2002)
	RI4	Customs/Import/Export Laws	Dedrick and Kraemer (2001); Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001),
	RI5	Exchange Rules/Rates	Dedrick and Kraemer (2001); Jain and Song (2002), Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri (2002); Sukovskis (2002)
	RI6	Travel/Visa Restrictions	Jennex, Amoroso, and Adelakun (2003), Rajkumar and Mani (2001), Smetannikov (2001)
	RI7	Telecom Regulations	Jennex, Amoroso, and Adelakun (2003), Palvia and Vemuri (2002), Rajkumar and Mani (2001),

OFFSHORE IT OUTSOURCING READINESS VS. ATTRACTIVENESS ANALYSIS: IMPLICATIONS FOR ECONOMICALLY EMERGING COUNTRIES

In this paper offshore IT outsourcing readiness is the availability and reliability of IT infrastructure and matured business processes at the offshore location. IT infrastructure includes hardware, software, network and all other IT skill needed on a given project. The IT infrastructure components directly impact the ability of the outsourcer to perform the system development project. It outsourcing attractiveness is includes all the supporting and peripheral factors and activities needed to develop the IT project.

Figure 1, the readiness vs. attractive model, shows a graphical representation of the mix between attractiveness and readiness categories while table 2, the Outsourcers' Critical Success Factor Model, further divides the readiness and attractiveness factors into outsourcers' internal and external factor groups.

External Readiness and Attractiveness Factors

Table 2 shows that the outsourcer operates within an external regulatory environment. This environment provides the legal framework in which outsourcer must operate. The legal environment is an important external attractive factor group because it can hinder the ability of the participants to perform the project, or it may encourage it. India is an example of an attractive regulatory environment that encourages outsourcing while Ukraine is an example of one that does not, therefore relatively unattractive.

Table 2, IT outsourcers' Critical Success Factors Model

Offshore IT Outsourcer Critical Success Factor		
	Internal (controllable)	**External (not controllable)**
Readiness Factors	Technical Infrastructure	Technical Infrastructure
	Business Infrastructure	
Attractiveness Factor	Client Interface	Regulatory Environment
	People Factors	

Participants also operate within an external technical infrastructure which comprised of each country's telecommunications and electrical systems, technical education systems, and availability of modern software and hardware.

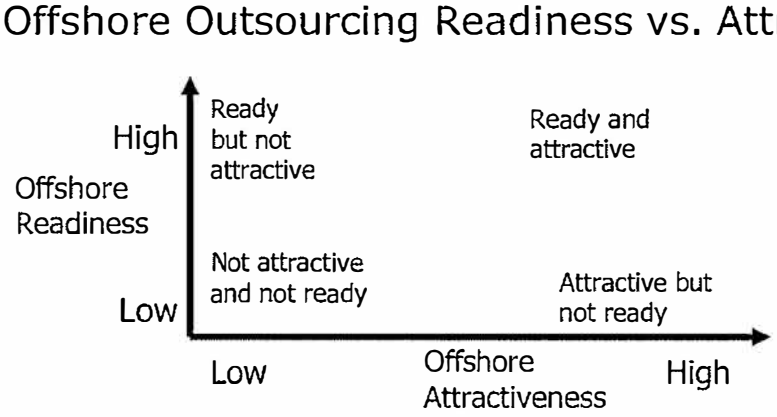

Figure 1. Offshore Outsourcing Attractiveness vs. Readiness Model

The more technical capabilities and resources in an offshore location the more the perceived believe that that location can deliver quality product and service on time and on schedule, thereby making companies in that location with higher technical ability to be at a higher readiness level.
Internal Readiness and Attractiveness Factors

Internal to the outsourcers are the client interface, internal technical infrastructure, business infrastructure, and people factors. The client interface is the defined communications process between the participants. The more matured a company's client interface is the more attractive it is to potential clients. This directly impacts the transference of requirements and project/process knowledge and guides the participants in the resolution of conflicts. The business processes of the outsourcer determine the likelihood that the outsourcer will remain viable for an extended partnership. The internal technical infrastructure ensures the outsourcer has the ability to develop systems. The more internal technical capabilities and resources an offshore outsourcer possesses the more the perceived believe that they can deliver quality product and service on time and on schedule, thereby making companies with higher technical ability to be at a higher readiness level. Finally, people factors ensure the outsourcer has the ability to understand the context in which the client operates. One major factor that makes India to be more attractive than many other Asia countries is that English is the major language for business and government. In addition to the English language, India is also a British colony giving them the advantage to quickly understand the western culture faster than other countries like China.

Overall, the Outsourcers' Critical Success Factor Model shows that outsourcers can directly influence and/or control internal critical success factors such as people factors, business infrastructure, and internal technical infrastructure. It also shows that outsourcers are impacted by external factors such as the regulatory environment and the external technical infrastructure but it is expected that the outsourcer will have little to no control or influence on these factors. Finally, the client interface factor group is shown to have direct impact on the way the outsourcer and client organizations interact but which neither organization has direct control over. However, both organizations influence the effectiveness of the client interface factors. It is expected that organizations in emerging economies will consider those critical success factors they can control or influence to be most important as they can actually do something about those factors.

CONCLUSIONS

The first question, what are the critical success factors for offshore outsourcers in economically emerging countries, was initially answered through a literature survey. The conclusion reached is that a list of critical success factors for startup outsourcers can be generated and that a smaller subset of critical success factors can be identified to determine offshore location readiness and attractiveness.

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Two of these, technical infrastructure and business infrastructure factor groups are used to identified readiness. These two critical success factors directly affect the ability of the outsourcer to meet the needs of the client. Startup outsourcers especially in economically emerging countries need to ensure they get technically qualified people with good general business knowledge. This is not an unexpected finding. The external technical infrastructure like telecommunication infrastructure is out of the control or influence of the outsourcer. This point out the critical role the government has to play to establish the readiness of an offshore location technically.

The last three groups of critical success factors people factors, societal interface, and regulatory interface were identified to determine attractiveness. Some of the attractive factors are also out of the control or influence of the outsourcer and the client. Example, intellectual property right protection and other regulatory laws are controlled by the governments.

Similar to previous research findings (Jennex and Adelakun 2003) cost was not the most important critical success factor given many researchers have highlighted cost as the primary driver for offshore outsourcing (Kumar and Palavia 2002; Rajkumar and Mani 2001). Comparing four countries along the readiness vs. attractiveness spectrum, based on pilot anecdotal data, we realized that the cost of programming in Nigeria is cheaper than in India but this does not make Nigeria to be a preferred offshore location over India. This indicates that awareness is growing that it takes more than low cost of programmers to ensure successful projects.

Ultimately, the value of these critical success factors is to startup companies as it provides insight into what it will take to be successful. There is also value to companies that outsource development as it provides a listing of criteria that can be used to help select an outsourcer.

Areas for Future Research

There are two major areas for future research. The first is collecting more data so that analysis of regional differences can occur. The second is comparative analyzes of few selected locations

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SESSION A2: RESEARCH PAPERS: THEORETICAL PERSPECTIVES

Implementation of Free and Open Source Software within a developing country context: The Cuban Case

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ABSTRACT

Many developing countries around the world are frequently confronted with a dual problem of developing infrastructure as well as implementing software solutions. Retrospective experience of licensing regulations and viral attacks are likely to indicate that part of the problem is a consequence of dependencies created by the use of proprietary software within the economy. Recent prominence of Free and Open Source Software (FOSS) has conjured up various alternative scenarios to replace the need for acquiring proprietary software within countries with limited resources. Cuba is no exception. However, there is an interesting background to the obtaining reality of software use within Cuba that makes it unique among several less developed countries. The present paper firstly delineates some of this background and then looks at the inherent advantages of using FOSS. This paper looks at the obtaining conditions in Cuba within which FOSS is being integrated into organisations and argues that there needs to be stronger political will to reduce gaps between goals and implementation for realising intrinsic advantages of FOSS use.

INTRODUCTION:

Exponential advances in information technology over the last decade have made maintenance of old and traditional IT infrastructure of a business, school or University substantially dear. Although such a rise in maintenance costs has affected public sector bodies globally yet economic and social progress of less developed countries seem to be affected rather more severely by such rising costs. Along with prohibitive costs of hardware, proprietary software is also a major expense. In an attempt to address the disadvantages of proprietary software purchases, there seems to be the emergence of a new and alternative worldwide community dependent on free and open source software (FOSS). According to Camara (2002) there are various advantages of FOSS use. Some of these include the feasibility to develop bespoke products in keeping with local conditions and users within different countries and organisations. Independence from stipulations of proprietary software as well as opportunities of sharing and modifying code as and when necessary are other advantages of FOSS pointed out by Camara (2002).

Given these characteristics of FOSS, it seems evident that integration of FOSS into software development and application creation strategies for developing countries should be hitherto considered more seriously. After the downfall of the Soviet Union in the early 1990s, several countries that were dependent on it for infrastructure and technology transfer have been rather badly affected. Cuba, being such a country, is worth consideration. Traditionally access to IT facilities in general and software in particular has been problematic within Cuba. The IT using community of Cuba have made various attempts at integrating and designing solutions to bring down costs and optimise advantages over the last decade. The issue of cost of licensed proprietary software is meaningful as the buying power of the Cuban population of such software is disproportionately small. Given such a wide differential, FOSS may be the only legal mechanism for a country like Cuba to acquire parity in any kind of IT exchange with the rest of the world. Over the last decade the IT using community of Cuba have made several attempts to integrate and in the process bring

down costs. However, most of these efforts have been sporadic and has lacked correspondence to progress achieved internationally. It seems logical therefore, that a greater use of FOSS within Cuba is likely to encourage development of reliable standards that would bring parity between international and local advances. The present paper looks at the obtaining conditions in Cuba within which FOSS is being integrated into organisations and argues that there needs to be stronger political will to reduce gaps between goals and implementation.

BACKGROUND TO THE CUBAN CONTEXT

Revolutionary changes to the obtaining political, economic and social conditions after 1959 led to the emergence of a unique context within Cuba. In response to the nationalisation of US enterprises within Cuba, the American government at the time imposed a trade embargo. The consequence of such a trade embargo has been exceedingly damaging as no country interested to trade with USA could trade with Cuba. The latter continues to be in place and has had a crippling effect on the Cuban economy.

The damage affected by such an embargo continues to be debilitating as no products, technology or services may be exported from the US to Cuba either directly or through third countries (U.S. Department of Treasury 2004). With respect to computers, it is illegal for Cuba to buy computers manufactured anywhere in the world containing even a single US component. Around 1960s, such an embargo brought about severe disadvantages to the Cuban government. Almost filling a vacuum, the USSR and its Soviet allies quickly became the primary supplier of all products, services and technologies needed by Cuba.

In line with these developments, various Institutes and Centres involved with assembling the first national computers were created in Cuba. These computers were to be built without any US made components as well as be run by software manufactured within Cuba. In 1969 the Central Institute of Digital Research (ICID from its name in Spanish) was founded (Valdes 2003). One year later the first computer (named CID 201) was built and by 1972 it was produced in series to be used in the sugar industry for both the control of processes in the sugar mill and the planning and control of cane transportation by railroad and trucks (Cuban Chamber of Commerce, 2003). Supported by the former Socialist Community, Cuba managed to develop in 1986 an IBM-compatible microcomputer named CID 1417.

In the early 1990s, without the support of the Soviet Union that Cuba received in earlier decades, it again lost a major part of its imports (about $4 billion-$5 billion in aid and subsidies), including technologies. The crisis made impossible to renovate or even maintain Cuba's telephone infrastructure. Consequently indigenous trends in growth in IT production were no longer effective. Once again the US embargo became a real problem for the Cuban IT industry.

It took nearly a decade to start overcoming such a crisis. By the late 90s, the Company for Information Technologies and Advanced Telematics Services (CITMATEL) was created and another company, Copextel, started a production line in Information Systems and Software. CITMATEL and Copextel have been in charge of assembling hardware and implementing software for the Cuban education system and industry. By November 2003, 46,000 computers had been installed in primary, secondary and pre-university schools in Cuba, and 12,800 had been installed in different universities ('Juventud Rebelde' 2003). By May 2004 there were 1,700 computers, including some with Internet access throughout the country. Such an implementation was possible through an important project addressed to teach IT related issues to children and young people in their free time (Granma, 2004).

Different sectors have also introduced IT in their day-to-day activities. Although not available to ordinary people in Cuba yet there are also computer shops where a variety of hardware and software based technologies may be found. These technologies are to be sold either to organisations under the control of the government or to foreign enterprises and persons resident in Cuba. However, it does not mean that Cuba is again producing computers, operating systems and application software for mass markets and audiences.

BREAKING THE EMBARGO

To maintain a network of dozens of thousands of computers in public schools and colleges throughout a country, some of them accessing the Internet, a significant budget needs to be spent on hardware and software. If software, like most operating systems is to be produced by U.S. based companies and thus is not available to the Cuban market, the problem is even bigger. To produce suitable software it is necessary, first of all, to have adequate scientifically competent human resources. However, preparing the human resources in the use of technologies requires technologies, and this is then a cyclical problem for the country. Despite difficulties computers are there, and are being used to prepare new professionals with suitable levels of understanding of ICT issues within different fields, including specific ICT subjects such as Computer Sciences, Informatics and Telecommunications. As well as most of the classics in the reading lists of these careers are unauthorised photocopies, surprisingly for Intel, that are being assembled in Cuba thousands of computers every year using its family of microprocessors. Surprisingly for Microsoft, the vast majority of such computers are running a copy –most of them the same copy- of operating systems from the Windows family and the Microsoft Office. Those computers are protected again from viruses using the latest versions of Symantec products. Those computers are the result of Cuba breaking the U.S. embargo, as well as exercising immunity to control policies of such companies.

THE EFFECTIVE REALITY OF THE CUBAN IT INDUSTRY

Concerning hardware, Cuba is buying computer components from third countries that take the embedded risks of violating the US embargo. Further these components are assembled in Cuba in the form of clones or in similar configurations. In the case of software, every Cuban professional who attends a conference abroad, who flies to any country on behalf of his organisation, is officially expected to bring, if possible, a copy of any useful book or software, even when it has to be bought. This copy is then shared and reproduced, within the community of IT managers in Cuban organisations. As long as computers are working properly, most organisations do not interfere in such processes. In the same way, many professionals from different countries –including the USA – who attend conferences in Cuba bring a copy of any useful software to "donate" to the Cuban organisation.

As an example of this, the following tables present some figures related to the number of computers in Cuba. Table 1 refers to computers per 1000 people and Internet users, while Table 2 shows the number of computers and software available in the Faculty of Communication of the University of Havana, analysing the period between September 1996 and September 2002:

Table 1: Evolution in number of personal computers and Internet users in Cuba between 1995 and 2002

	1995	1997	1999	2001	2002
Personal Computers (per 1000 people)	Not available	5.70	9.9	19.6	31.8
Internet Users (thousands)	0	0.1	35	120	121

Sources: Development Data Group, World Bank
Computers: Economic Eye on Cuba, September 1, 1997 (Press, 1997)

Table 1 above shows the growth in the number of computers available in Cuba, which was in 2002 (the last date available) three times the quantity of 1999. Internet access also rose nearly 4 times in three years.

Table 2: IT availability in the Faculty of Communication, University of Havana

Year	Number of Computers	Operating System	Main application software available	IT-based Information Services
1996	**2**	MS-Windows v.3.1 running on top of MS-DOS	MS Office and mail programs	One single Email address for Faculty's official issues
1997	**6** 4 second-hand PCs. (interconnected)	MS-Windows 95	Microsoft Office, Norton Antivirus	Still a single email address.
1998	**11** 5 new computers with Pentium microprocessors	MS Windows NT v.4.0	Microsoft Office, Norton Antivirus, Microsoft Visual Studio	Still a single email address.
1999	**35** 24 new interconnected computers Celeron; CD-Writer, printers, scanners.	MS Windows NT v.4.0. Linux in the servers.	Microsoft Office, Norton Antivirus, Microsoft Visual Studio; SPSS and several application software	Internet access in 10 computers: 5 for students and 5 for lecturers; Email service for lecturers; One email address per team of 5 students. 3 computers in the library to browse the internet.
2002	**> 40** digital cameras, etc. wireless connection to internet.	MS Windows XP Professional; Linux in the servers	All latest version of the software available.	Same as before plus: Website and intranet running with access to the library.

Source: Based on the experiences of second author

Table 2 above demonstrates the growth of availability of hardware and software in a typical higher educational institution in Cuba. The Faculty of Communications represents the situation of most of Havana University and other similar Universities and colleges. However, this does not mean that there are no valid copies of software in Cuba. There are different projects involving people and organisations from several other countries that provide copyrighted versions of software required by such projects.

Thus, breaking the embargo seems to be a panacea to all Cuban ICT problems. However, this solution – while seemingly definitive – is a short-term answer to Cuban ICT needs. As even when the embargo by USA comes to an end, Cuba will continue to be a developing country.

While a piece of hardware can be used for years without being upgraded, having a copy –legally or not– of any software that suits the company's needs will never be enough. The company won't be able to avoid the need to upgrade it, even if there is no internal reason or interest in doing so. File formats are changing or new ones are emerging and the company risks that their programs are not able to process new documents

even created by newer versions of the same application. Given such a background, it would be appropriate to consider the case for FOSS in the context of the Cuban scenario.

OPERATING SYSTEMS AND UNIVERSITIES: THE CASE OF LINUX

Around September 1998 the first connection of the University of Havana to Internet was made using a channel provided by a Canadian-Cuban project. The computers used to this purpose in the node of the University of Havana (UH) were using UNIX and Windows operating systems. Shortly, the first faculties and research centres were connected. The abovementioned Faculty of Communication was tried to be connected using a pirate copy of Windows NT Server. After two months of trials, the conditions of the leased line used to connect the Faculty to the UH node, the characteristics of modems available (certain models of *Zyxel*), and the weather conditions in Cuba (frequent winds, electric storms and hurricanes) made the staff working on the project to try and use a version of Linux, a free operating system that was purported to be reliable.

It took extensive reading because of the lack of practical experience in such matters. When the first test was made, it was established a solid connection and the Faculty of Communication was connected to the Internet using the UH node as no one else had done it. The model was then expanded to every Faculty and Research Centre of the University and in one year time all the communications in the UH were Linux based. From late 1998 to the date the University of Havana has had Linux Servers (using different versions of Linux, mainly *Red Hat* and *Debian*) for external communications.

However, the workstations and servers within the University are still running Windows NT, Windows XP and Microsoft packages. Is it difficult to find a legally acceptable solution for this problem?

If it is true that the acquisition of hardware will continue to be a problem for Cuba –not only because of the lack of resources but also due to the U.S. embargo– the situation with software could be alleviated (if not totally resolved) by the local IT community.

FOSS: A viable alternative

Open Source movement then offers two main advantages for developing countries like Cuba:

1. The possibility to access and use free software, and
2. The possibility to modify source code, adapting the application to local users' needs.

The first would help to avoid paying high costs of software ownership that normally varies between 15 and 60% of the total cost of the software. In general, whilst the average income of a Cuban IT professional is less than $180 a year, the current cost of a copy of Microsoft's XP Windows Professional according to Amazon.com is $279.99. Such a cost and wage differential implies, that a Cuban IT professional would need more than 18 months income to pay for a single legal copy of a proprietary operating system. Such a wide cost disadvantage does not only apply to the Cuban case but is endemic for most of the developing world. Disadvantages as a result of acquiring proprietary software in developing countries are compounded with existing barriers such as bandwidth. Whilst infrastructural weaknesses like the need for higher bandwidth would require state support, cost disadvantages as a result of proprietary software use is quite easily resolvable with adequate FOSS support.

Using FOSS would help overcome this problem by allowing schools and colleges, which include most computers available to the Cuban population (more than 60,000 by the end of 2003), to have legal access to all kinds of software, from Operating Systems to Office and task-specific tools. Private computer owners, who are a very small percentage due to the Cuban conditions, would also be highly benefited by such a move.

The second advantage, which is even more important, makes it possible for Cuban IT professionals to offer local institutions the software they need, avoiding the expensive and long process of designing bespoke

applications from the very beginning. By modifying the source code of most application software, they can customise them according to the local requirements and even provide improvements to software, as it is one of the objectives of the open source software community. Apart from these inherent advantages there are a few other dimensions that ought to be considered as contextual to the Cuban case.

Language barriers

Most applications available both as FOSS and on proprietary basis have English based interfaces. This may be a problem for people and institutions across a wide range of non-English speaking countries. Local FOSS community in every country could adapt software by changing its interface to a language and share it with people who speak the same language. Such an alternative exists only if the original software is likely to be available on open source basis.

Flexibility

Through the modification of source code of most application software IT professionals can customise software according to local requirements of particular organisations. Usually such modifications entail the addition of new features or the removal of others that are felt to be less important.

Performance

As with the mentioned case of Linux at the University of Havana, a wide range of software available through the FOSS mode usually performs better than their proprietary counterparts. Such performance is also based on the capacity to be adapted to different hardware and other obtaining connectivity conditions. Security is another issue where thus far FOSS has proven to be superior despite Linux being threatened by a variety of viral attacks.

Developments within the local IT community

FOSS development in every country increases the number of local professionals working on IT developments and also their capacity to design and implement software to solve different kinds of problems by interacting with their counterparts worldwide. Such growth may be produced with minimum investments in training such personnel as well as having their continual support to the national economy.

There are other advantages of FOSS that make it a liable solution to the conditions of Cuba as a developing country. Among them:

- The use of FOSS has marginal demands on hardware in the process users are able to use such software with minimal memory and processing power. The latter happens to be costlier to acquire within developing country contexts.

- Compatibility of FOSS based operating systems and applications within proprietary software. For instance, adaptability of FOSS like Linux to different hardware and connectivity conditions.

- Current existence of a large number of applications designed under FOSS principles.

- Expansion of the FOSS community to many DCs, where projects have been successfully developed. Some examples from Brazil, India, Tajikistan and Laos have been studied by Dravis (2003).

INTRODUCTORY STAGES OF DEVELOPMENT

The current situation of software in Cuba has made a community of professionals from diverse subject areas to join the FOSS community, led by students and specialists of Computer Sciences and Information

Management. They are engaged in a national 'project' called Linux-Cuba, which is aimed to promote use of such operating systems and create a set of resources to help and increase use of FOSS in Cuba.

Linux-Cuba provides free resources to the national open source community, organises conferences and workshops and offers free courses nationwide, obviously opened to the international community of Linux users. As initiatives such as Linux-Cuba are not part of official responsibilities of any organisation, professionals involved do not receive any support other than – in some cases - the facility to use in their leisure technologies available within the organisation. Lack of possibilities for Cuban professionals to have their own IT resources hinders strengthening of Linux-Cuba and any other independent initiative.

The Cuban government is said to recognise the need to prioritise FOSS developments existent within IT regulations. To that aim it has defined a strategy for using free software to develop a national software industry based on open software principles (*Ministerio de la Informatica y las Telecomunicaciones de Cuba,* 2003). This strategy is still to be implemented, which will be a difficult process. The Cuban government is obviously considering development of the national FOSS strategy as a conventional IT software development project. In this context there are a few important issues that are worth considering here:

- The cost of implementing the strategy will be high:
  - On the one hand, resources and time will be needed;
  - On the other hand, it will require offering IT professionals, freedom to access, use and modify online resources from within the FOSS community. This challenges the Cuban Internet policy.

- The outcome of the process is likely to lead to software development that is not to be sold. So, the process supposes to invest some time, resources and effort in producing something that won't seem to bring about direct economic benefits. As schools and the economy are now running without such software, it is important despite not being a priority to develop alternative legally acceptable software.

- Quality of contributions of members of the Cuban coding community connected to FOSS can be good. However, as they won't be paid for such a work level of effort and consequent quality of outputs might be suspect. This could be seen as a problem already exposed by the FOSS community. However, conditions of Cuba as a socialist and developing country make the situation of its professionals completely different to DCs with a different socio-political system.

Some efforts have been made to develop IT professionals in the country to cover needs of the economy and even to develop a Cuban software industry. Apart from the careers Computer Sciences (more than 30 years running in the University of Havana and three more universities) and Informatics (more than 20 years running in several universities throughout the country) one more university was created in 2002 with the only aim to create IT professionals. The centre is called University of Informatic Sciences; it is located in Havana and its students come from the whole country. This university provides special conditions and resources to large number of students and staff, not available at any other school in the country. The first graduates will be ready to go to the Cuban industry from 2007 revolutionising the IT environment.

Another attempt to develop and use local solutions to the IT-related problems in Cuba is the production of software to provide the national market with products such as antivirus programs. Segurmatica, a company created a decade ago with such an aim has been trying –with the help of government policies - to replace the use of pirated copies of proprietary antivirus software with the so-called SAV (from Segurmatica AntiVirus). Unfortunately these efforts are in a very early stage and have not produced the expected results.

Infomed, the Cuban health information network has been running from 1994 using Linux. It has also developed a totally free hospital-management system which is set to be very important for third-world countries that want and need open-source software (Hanson, 2004) and a virtual library of medicine available to the Cuban and international medical sector (Riera 1999). However, this is an organisation with political purposes, supported since its foundation by the Cuban government, so the development of such a

network is an investment addressed to internationally disseminate advancements in the Cuban health systems. Nationally, the network and its resources are rarely accessed by the Health professionals.

SOCIAL DIMENSIONS OF IT DEVELOPMENT

There are a couple of dimensions affecting the widespread use of FOSS in Cuba. The first relates to the economic reality that has been discussed earlier. The second relates to the social conditions that are conducive to integration of FOSS. Available support by the Cuban government to the people is an important indicator of whether FOSS will actually be able to upgrade resultant human capital. Every year whilst there is the addition of hundreds of new computer-related professionals in Cuba yet only a few have the post qualification support necessary for them to enrol or to continue to be enrolled into the FOSS community.

While students, they have access to PCs at schools and probably an email address. In the best of the cases the schools offer access to the Internet to their staff and students. When they finish their degree they will be allocated to a workplace without technologies at all or with too many restrictions in the use of the technologies available. In 2000 the only computer with Internet access in the printing press of "*Granma International*", an official newspaper also available online, could be found in a notice board behind glass panels with a list of a few names of people with access to internet enabled computers. New employees at such press offices were recently graduated students who had been using the Internet and email during the previous five years. Invariably, legislations on PC sales and Internet access are not helpful for FOSS community development:

PC Sales

In March 2002 the Cuban government banned sale of computers and computer accessories to the public, except in cases where the items are "indispensable" and the purchase is authorized by the Ministry of Internal Commerce (Scheeres 2002). According to Article 19, Chapter II, Section 3 of the ministry's Resolution No. 383/2001: "The sale of computers, offset printer equipment, mimeographs, photocopiers, and any other mass printing medium, as well as their parts, pieces and accessories, is prohibited to associations, foundations, civic and non-profit societies, and natural born citizens. In cases where the acquisition of this equipment or parts, pieces and accessories is indispensable, the authorization of the Ministry of Internal Commerce must be solicited."

Access to Internet

In January 2004 the Cuban government decreed a crackdown on unauthorized Internet usage, ordering the state telephone monopoly ETECSA to stop unofficial access to the network by its users. Days later, apparently responding to a wave of protests, the main ISP in Cuba announced that home users could connect if they paid in dollars.

Prices

Although e-mail accounts are available at the Cuban Postal Service, its use is not affordable by Cuban professionals: A three-hour prepaid card costs $4.50, one-third of the average Cuban monthly wage. To afford Internet accounts and browse the network the Cuban web surfers need to pay 8 cents of US$ a minute, which is a prohibitive rate with regard to the average Cuban salary (Reuters 2004). Acquiring a Personal Computer is also beyond the economic wherewithal of the average Cuban IT professionals. Even when they were authorised to do it, they would need to pay more than $500 for a Personal Computer, as shown by TECUN (2004), one of the Cuban IT shops.

Bringing a Personal Computer from abroad could be a solution to the problem of unaffordable PC prices. However, it also creates enough problems to avoid people entering equipments into the country as they should follow the same rules as to buy the PC in-country. On one hand, due to government regulations and the need of permissions for temporary flight to other countries, number of professionals who travel every year is small. Those who manage to get the support needed to attend a conference or to represent the government in a different country sometimes acquire a new or second-hand PC. However, they will need

the authorization of the corresponding Ministry to enter Cuba with a privately owned PC. The ministry whilst deciding would consider whether such a PC it is indispensable or not to the owner.

The bulk of tasks to be accomplished by Cuban professionals leave no extra time to spend in developing a piece of software for the organisation. Access to Internet, which is a prerequisite to be part of the international FOSS community, would no longer be available for the vast majority of professionals and thus the motivation to continue previous works or start new projects will fall. The lack of freedom of possessing a computer and access external information obstructs to a large extent, the possibility to develop a FOSS programme in Cuba.

CONCLUSIONS

By adhering to the Free and Open Source Software community Cuba could, as a developing country, obtain several economic, legal and even political benefits. Cuba is just starting the efforts to develop the free and open software in a national context. However, on the other hand the obtaining situation in Cuba is conflictual. Whilst paying lip service to the implementation of FOSS the government at the same time tends to antagonise freedom with corresponding restrictive policies in the widespread use of the internet and the possession of a PC.

The level of educational training in Cuba could lead it to be one of the main players in the FOSS community. However, this would imply a change in the way IT and the Internet is seen by the current government, which far from helping the population to access Information available worldwide, hinders any possibility of having a PC or easily interact with professionals living abroad. To develop the Cuban FOSS sector this issue needs to be seen in isolation from the scenario coloured by political compulsions. In order for a national FOSS project to be robust and secure, developers working on such a project will need access to the source code, supported by as many companies as possible from those interested in the results. The definition implies access to resources, so the strategies must cover the ways to satisfy such a requirement. There are adequate IT resources in Cuba to facilitate people joining the FOSS community. Appropriate management of available resources is likely to be able to allow it. The software crisis in Cuba could be resolved by suitable utilisation of the combined experiences, available resources and clear reliance on FOSS. It is ironical that a government that fought for the freedom of the country through the revolution that brought Fidel Castro to power in 1959 is now ceaseless in its endeavours to restrict the individual freedoms of its current population. Somehow technological advances seem to have overtaken what can be achieved by traditional notions of control. Despite poverty and lack of resources societies are forever discovering new mechanisms to survive and grow therefore the current government in Cuba instead of wasting more resources on restricting people from acquiring access to information could encourage the use of FOSS. The latter as was made obvious through the evidence presented in the paper does not entail any new commitments of funding or resources but a general establishment of trust and an environment conducive to self-sufficiency.

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Towards E-Government in Nigeria: Shortcomings, Successes, Swish or Sink

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ABSTRACT
Governments all over the world have embraced one form of e-government initiative or another as they march towards digital governance in the new Information Age. The developing world is not totally left behind in this new race. To that end, this paper presents the move of one developing country - Nigeria - towards embracing e-government. The article discusses the problems, practices, and prospect of e-government in the country. The paper concludes by highlighting the need for Nigeria to step up its effort with regard to a changing world on the digital front. In addition, some recommendations relating to use of information and communication technologies (ICT), its adoption and diffusion in the country as well as its human resource development implications, are succinctly discussed.

1. INTRODUCTION
In this information age many governments and societies are embracing one form of digital governance or another (Heeks, 1999; Cottrill, 2001; Moon, 2002; ASPA, 2003). African governments are not totally in the dark as to what the benefits of e-governments are, and have since being making attempts to "catch-up" (Thomas et al., 2004; UNECA, 2004). E-government can bring about interactions that could have profound impact upon the socio-economic developments of developing countries (DC) such as Nigeria (see, Heeks, 2002; *Info*Dev, 2004). To begin with, our definition of e-government leans towards The World Bank's (*Info*Dev, 2004) wherein e-government is described as the use of information and communications technologies (ICT) to transform government by making it more accessible, effective and accountable to its citizens. E-government involves the utilisation of technologies such as the Internet in improving services, functions and processes of governance (Heeks, 2002; Breen, 2000; Navarra and Cornford, 2003). Realistically, it is more than setting up of a Web server and hosting governments' web sites on it, though the Internet plays a prominent role in e-government. The World Bank guidelines on e-government initiatives for developing countries aim at using e-government to promote civic engagement by enabling the public to interact with government officials/functionaries and vice versa; to provide accountable government that makes its operations more transparent and thus reducing the opportunities for corruption; to provide greater access to government information and activities; and, above all, to provide development opportunities especially benefiting rural and traditionally underserved communities (*Info*Dev, 2004). Furthermore, the American Society for Public Administration (ASPA) notes that "E-government is about opportunity. ...opportunity to provide cost effective services to the private sector contributing to the development of business and promoting long-term economic growth ... opportunity to enhance governance through improved access to accurate information and transparent, responsive and democratic institutions" (ASPA, 2003).

That said, the objective of this paper is to present the effort of Nigeria towards adopting e-government as the country makes attempts to tackle the underlying problems that brought about the shortcomings to e-government initiatives in Nigeria. Also, successful endeavours or activities in relation to the move towards e-government are discussed. Our discourse also touches on areas demanding swift actions in which the Nigerian policy makers must not neglect. In the same vein, the danger of failing to join the bandwagon of e-government adopters is highlighted.

2. RESEARCH FRAMEWORK
The framework and methodology used for this study borrows from the Tornatzky and Fleischer's (1990) model of the process of technological innovation and Wolcott et al.'s (2001) global diffusion of the Internet

framework. Firstly, Tornatzky and Fleischer's (1990) model has three components impacting the adoption and implementation of innovations; namely, factors from the technological, organizational and external environments. Arguably, e-government may be described as an innovation; at least from the point of view of a DC like Nigeria. It is noteworthy to point out here, that we are not dealing with the implementation of *e-government*, per se; rather we are interested in issues pertaining to the environmental factors affecting the growth of the concept of e-government in our selected country - Nigeria. The country is among the fastest growing markets for telecommunications in the West African sub-region (Ajayi, 2003; Hamilton et al., 2004; Thomas et al., 2004); as such, we are of the view that the environment for e-government adoption may be more suitable to investigate vis-à-vis other countries in the region. Secondly, the paper uses the Wolcott et al.'s (2001) global diffusion of the Internet framework that has six components – connectivity infrastructure, geographical dispersion, organisational infrastructure, pervasiveness, sectoral absorption and sophistication of use. These items are modified to accommodate our discourse: e-government diffusion in Nigeria. Moreover, some researchers have used both models to discuss e-commerce adoption, which is a related concept (see, Okoli and Mbarika, 2003; Scupola, 2003). In particular, Scupola (2003) discussed the benefits and barriers of e-commerce under the technological context – an approach which this present paper follows as it deliberates e-government in Nigeria. See Figure 1 below for the research study framework.

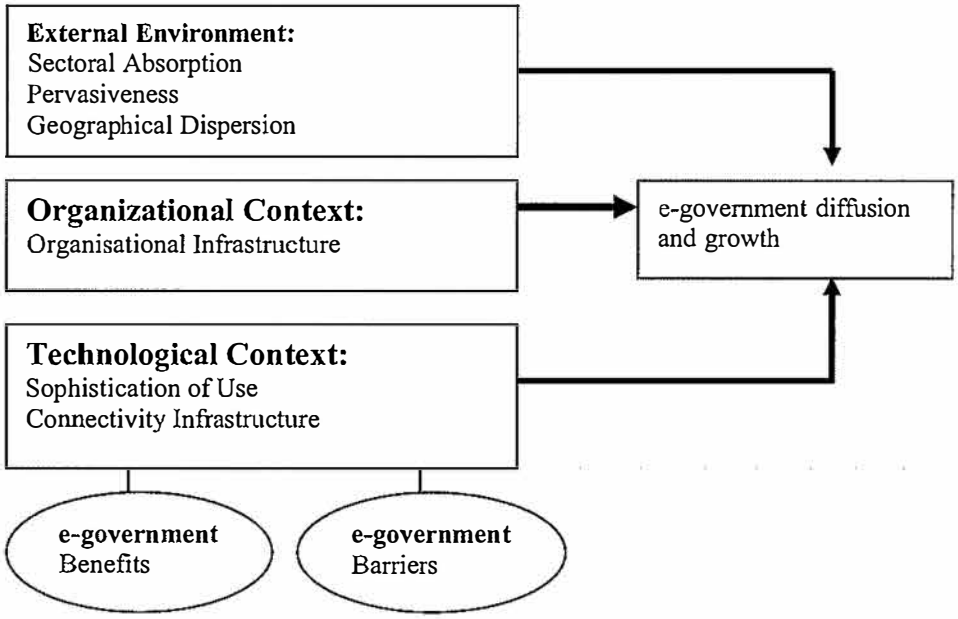

Figure 1: Study framework of e-government in Nigeria

Generally speaking, e-government has arrived in most parts of Africa including Nigeria (Heeks, 2002; UNECA, 2004; *Info*Dev, 2004; Thomas et al., 2004) though it is viewed according to some commentators as an imported concept based on imported designs (see, Heeks, 2002). In the American Society of Public Administration's (ASPA) publication of e-government initiatives of countries, Nigeria is grouped among countries with minimum e-government index. Nigeria has a rating of 1.02; on the other hand, the US rated highest with 3.11 on that index. The global index was average at 1.62 (ASPA, 2003). This low rating suggests that more needs to be done for Nigeria regarding e-government's diffusion and growth. To that end, it would worthwhile to have an understanding of the e-government environment and contexts in Nigeria, which we discuss as follows:

Sectoral absorption: This is used to indicate the sectors within the Nigerian state where e-government is most likely to be used. The national IT policy (Ajayi, 2003) has slated e-government model to cover areas such as *eAdministration* (citizen-centred administration and planning), *eHealthcare*, *eTaxation* and revenue management (On-line taxation), *ePopulation* (citizen registry), *eAccounting* (budgeting and management), *eEducation* amongst others. It remains to be seen if these initiatives will come to fruition considering the barriers to e-government in Nigeria (these are discussed in latter part of this paper).

Pervasiveness: Refers to how many individuals or organisations in the country engage in any form of e-government. The very low level of ICT use and diffusion in Nigeria (Dutta et al. 2003; ITU, 2004) indicate that the various enablers of e-government such as telecommunication facilities are limited in the country; as such, e-government won't be widespread at this point in time. Nonetheless, the effort of the government and other stakeholders in the country (Ajayi, 2003; Ajakaye and Kanu, 2004) may help bring about change.

Geographical dispersion: This item indicates the extent to which e-government engagement is spread across the nation. There is urban-rural divide in terms of access to ICT in Nigeria (Ajayi, 2003). This would mean that e-government may be an "urban centres luxury"; or an "elitist play tool".

Organisational infrastructure: This refers to the organisational ambience for e-government to thrive. So far, this appears to be encouraging in Nigeria. With the liberalisation of the telecommunication industry and the granting of licences to ISP operators such as Linkserve, Supernet and others; Nigerians are poised to exploit e-government initiatives.

Sophistication of use: This deals with the extent to which individuals in the country may use e-government platforms in lieu of traditional methods. Studies suggest that due to lack of trust and prevailing traditional norms, e-government initiatives may not be easy, a notion to sell to Africans. For example, Okoli (2003) notes the need for tactile contacts in business dealings among Africans. Similarly, Foster et al. (2004) writes of the lack of trust on such issues for Africans. This could imply that the sophistication in the use of e-government tools in Nigeria may turn out to be low due to some of the reasons discussed above. Furthermore, Ojo (1996) and Woherem (1996) note that where computing equipment are available, more often than not, they are under-utilised and ill-utilised due to lack of skills.

Connectivity infrastructure: This deals with the extent to which individuals of the nation have access to the necessary infrastructure for engaging in e-government. According to Okoli and Mbarika (2003), "the Sub-Saharan Africa region [including Nigeria] has historically lagged behind the rest of the world in constructing viable connectivity infrastructure needed...". Although, many major cities in Nigeria now have some form of Internet access (Ajakaye and Kanu, 2004), the cost of acquiring access for an average citizen is still astronomical.

2.1 Some Barriers to e-government in Nigeria

First and foremost, the external environment in which Nigeria is placed, impacts on the diffusion of e-government initiative. Nigeria is an African DC that is best described by paradoxes. It the most populous country in Africa and has a population of about 135 million (World Bank Group, 2004). It is an oil-run economy; as such, one would expect that everyday gadgetry such as computers should be common-place items vis-à-vis its oil proceeds. On the contrary, Nigeria ranks among the poorest countries in the world (World Bank Group, 2004). The availability of the enablers of e-government, such as ICT equipment, good electricity generation are difficult to come by, for an average citizen. Also, there is a wide gap between urban-rural dwellers in the country with regard to wealth (Daily Champion, 2004) and access to ICT products (Ajayi, 2003). Urban dwellers fare better than their rural counterparts. However, there is progress in Nigeria over the last few years in regard of ICT products diffusion (Mbarika et al., 2002; ITU, 2004; Hamilton et al., 2004).

Regarding the Nigerian organisational context, the country missed the opportunity to build on past events that would have made e-government diffusion easier, at least from the perspective of pervasiveness of computers in the country. Record from the Federal Office of Statistic (FOS) shows that the first computer sold in Nigeria was to the Nigerian Ports Authority (NPA) by ICL in 1948 (UNU, 2004). By the 1960s some governmental establishments have started using computers and other ICT products. Thanks to lack of political will, these modest achievements got lost. Furthermore, during the late 1970s the Nigerian government set up a committee named Central Computer Committee (CCC) to develop inputs for the national policy on computing as well as create standards for users and vendors (UNU, 2004; Ifinedo, 2004). This body turned out to be short-lived achieving little or no success. The country had no national IT policy until 2001! It has to be said that the new body created to manage the state's IT policy does not follow the example of CCC. In sum, the organisational acumen needed to create an enabling environment for e-

government is lacking in many developing countries including Nigeria (Odedra et al., 1993; Ojo, 1996; Woherem, 1996; Heeks, 2002). Also, the socio-cultural environment in Africa is different from the West where e-government has its origins. Ojo (1996) asserts that IT and other technology-based disciplines will thrive better in cultures that have a mechanistic view of the world, unlike in Africa where informality thrives. As such, an attempt to transfer the notions of e-government to Nigeria without having a thorough understanding of the society is doomed to failure. For example, Heeks recounts examples where e-government efforts in Africa totally or partially failed due to "people" factors. The culture of self-motivation amongst public functionaries in Nigeria, the tendency to over-politicise decision-making, and the urge for secrecy and bureaucratic complexity are cited by some researchers as among the reasons why governance is poor in the country (see, Ojo, 1996; Heeks, 2002; Ifinedo, 2004; 2005). Others described such problems as relating to internal resistance and culture of corruption (Thomas et al., 2004), which is rife in the Nigerian society.

E-government does well in societies where illiteracy is non-existent (ASPA, 2003; Dutta et al., 2003); by contrast DC of Africa are way off, on such issues. The problems of adult illiteracy and the general lack of IT education among a large segment of the population, is a barrier to e-government in Nigeria as sophistication of use as regard e-government is impacted. E-government thrives when the populace have access to the right equipment, which are affordable. The reality on the ground in Nigeria does not give support to the diffusion of e-government practices. Mainly, inadequate infrastructure is a problem (Ajayi, 2003; Development Gateway, 2004; Maombe-Neko, 1996; Dutta et al., 2003). Power generation at best is unpredictable. As was mentioned, the availability of ICTs, a *sine qua non* for the growth of e-government, is very limited in many a DC (including Nigeria) (Dutta et al., 2003; ITU, 2004; World Bank Group, 2004; UN ICT TASK Force, 2004). Additionally, the under-utilisation and ill-utilisation of technology (Woherem, 1996) is rife in most DC including Nigeria. Even where computers are found, their uses sometimes don't go beyond clerical operations. This problem is perhaps caused by the fact that Africa has become a dumping ground for technologies from elsewhere (Odedra et al., 1993; Woherem, 1996; Udo and Edoho, 2000). IT vendors in most DC have the "dump and run" attitude. Similarly, the attitude of foreign entities that *transfer* technology to African countries is suspect (Udo and Edoho, 2000). And, so is the lack of content and governance for Africa in ICT fronts (Wade, 2001; Mutume, 2004). Furthermore, the dearth of the sorts of skills required for effectively maintaining and managing e-government initiatives such as project management and technical skills are not easy to come by in Nigeria. Inevitably, the move towards e-government endeavours is negatively impaired as a result of the shortcomings (Odedra et al., 1993; Ojo, 1996; Heeks, 2002; Dutta et al., 2003; Ifinedo, 2004). In sum, connectivity of the populace for the necessary infrastructure needed for e-government is lagging behind in Nigeria.

2.2 Prospective Benefits of e-government in Nigeria

The prospective benefits of e-government for Nigeria have been discussed elsewhere by the co-author (Ifinedo, 2004; 2005). Here, we provide a summary in this paper. It widely known that the Nigerian society is hobbled by political instability, corruption, and rampant inefficiency (Ojo, 1996; Idowu, 1999). These are the sorts of problems that e-government help to attenuate (Info Dev, 2004). Thus, we will discuss the benefits of e-government initiatives along the directives of United Nations' Millennium Development Goals (MDG, 2000) and other similar bodies (see, WSIS, 2004), where DC are said to be able to transform their societies with the aid of ICT. Interestingly, some commentators express doubts as to whether ICT use (and in governance) alone could transform developing countries (see, Castells, 1999). According to Blackmore and Dutton (2003), "change can be driven by technology, and technology also can be moulded by need for change". As such, we are of the view that e-government could help usher in a change regarding redressing such aberrations as rampant corruption, inefficiency and so on plaguing the Nigerian society. The benefits are discussed thus:

Economic growth: As ICTs, including the Internet become widespread and accepted in the country, jobs relating to its use are created; foreign investors are attracted and the government acquires new sources of income from businesses spawned by digital or electronic initiatives. The granted ISP licenses and Cybercafé diffusion in Nigeria bears this out.

Efficiency and effectiveness of government services: Interoperability between government agencies increases, and duplication of services may wane. As a result, the cost effectiveness in governance is

palpable through the implementation of common standards. Improved services encourage better decision making effort and the availability of electronic data could help put end to corrupt practices or curb its spread. The Public Service Network (PSNet), discussed below could be useful in this regard.

The transformation of the society: It is generally known that ICT (and e-government) projects in many countries are contributing towards the total transformation of those societies (Rupp, 2002; Avgerou, 1998; Cottrill, 2001). For example, government services are brought closer to the people, say e-health, e-taxation, e-judiciary and so on. Likewise, governance and democracy may have a new meaning for citizens, a departure from the *status quo* – an average Nigerian does not believe s/he is a part of the government. Thus, a properly constituted e-government initiative may facilitate empowerment for citizens. For example, Nigeria could take a cue from some documented successful e-government initiatives by The World Bank (*Info*Dev, 2004). An example includes the Namibian Parliamentary web site where citizens to participate online in governance. The Parliament of Namibia engages citizens in the democratic process by affording them the opportunity to participate online in political discussions, and the opportunity to stay up-to-date with the legislative developments of the Namibian Parliament. This sort of initiative could help bring aboard Nigerians who believe they have no say in their governance. Other initiatives include the launching of e-Government portal in Egypt. Citizens in Egypt and foreigners as well as businesses are offered services including on-line payments, acquisition of birth certificates and so on (Development Gateway, 2004). At the moment, e-payment is minimal or non-existent in Nigeria. In Kenya, there is an e-Health initiative that harnesses ICT to improve the health of rural Kenyans. ICT use in the Nigerian healthcare is poor. Revenue collection in Nigeria is inefficient with lost income to the state through ineptitude and corruption. E-taxation could help fix this problem. For instance, Mauritius has reported success with its online taxation systems. And, use of ICT for electoral purposes in South (*Info*Dev, 2004).

3. E-GOVERNMENT INITIATIVES SUCCESS STORIES IN NIGERIA

The e-governance success stories in Nigeria will be evaluated against the objectives of the G8 DOT Force (2001) and UN ICT TASK Force (2004). Essentially, these bodies are of the view that governments around the globe should set their agenda around "fostering policy, regulatory and network readiness; improving connectivity, increasing access and lowering cost; building human capacity by focusing on education and lifelong learning with emphasis on IT skills; and encouraging participation in global e-commerce networks and other e-networks" (DOT Force (2001). In Africa, under the NEPAD (New Partnerships for Africa) initiative, the e-Africa Commission oversees Africa's effort in regard of ICT development. Thus, we discuss Nigeria's success as follows:

Fostering policy and network readiness: Nigeria now has its national IT policy, which was inaugurated in 2001. The IT policy is under the auspices of NITDA (National Information Technology Development Agency), a body manned by seasoned technocrats. The mission statement of the IT policy includes "USE IT" for education, poverty eradication, wealth creation, global competitiveness and job creation. According to the Minister of Technology, "Having achieved considerable success in public enlightenment, ... the stage has now been set for a holistic approach to the development of software in Nigeria so as to attain the level of global competitiveness as in countries such as India". This remark was made in August 2004 at the inauguration of the national software development taskforce. The foregoing remarks by the Minister suggest that the country is on course to achieving some of the goals outlined by world bodies IT task forces. In terms of local content provision, the country does not have any known portal such as Yahoo, and the few ones in the shadow of popular portals operate from overseas. One example is www.nigeria.com. Importantly, Nigeria has secured some domains names for itself (see, NITDA, 2004).

Improving connectivity, increasing access and lowering cost: For instance, with respect to infrastructural development, according to NITDA (2004), Nigeria is making progress as it develops its national telecommunication backbone. NITEL (Nigerian Telecommunication Ltd.) has started installing optical fibre network links to major cities in the country. This initiative benefits from the US$637million optic fibre network (SAT-3/WASC/SAFE) snaking along the coast of Africa (Ajayi, 2003). Also, several public and private VSAT operators now operate to improve Internet services in Nigeria. Other projects in Nigeria include the Public Service Network (PSNet), which was largely conceived to ameliorate major problems associated with low levels of ICT infrastructure in Nigeria, and especially in the public sector (Ajayi, 2003). This particular project serves as a pipe for ICT services within the country. It comprises a Very

Small Aperture Terminal (VSAT) sited in State capital – Abuja. This VSAT provides Internet access for Abuja and it is connected with Broadband Wireless Access (BWA) technology. The various sites around the country are then linked up through a Virtual Private Network (VPN). So far, nine states have being linked in the first Phase of the project and others are on-going (Ajayi, 2003; NITDA, 2004). There are many ISP operators in Nigeria and the government is working with such operators to lower their tariffs. The last achievement, by no means the least, is the emergence of home-made computers in Nigeria (Ajayi, 2003; Ifinedo, 2004). Hitherto, all computers used in the country have been imported. This development will hasten the diffusion of computers to homes, schools, workplaces and so on, as affordable computers come within the reach of average Nigerians. These initiatives hasten the environment for e-government to thrive.

Building human capacity by focusing on education: The Nigerian University Network (NUNet) is a project that focuses on the development of human capacity within the academia in Nigeria. It is aimed at training staff of 46 Nigerian universities using ICTs. This is done in collaboration with ICTP (International Centre for Theoretical Physics - Trieste, Italy). One prominent achievement of the project is the effort of the University of Nigeria, Nsukka (partnered by ICTP) in organising an entire PhD programme in Mathematics electronically. This is a novelty in Nigeria. NITDA has developed a thriving partnership with private organisations (including multinationals such as CISCO) to train Nigerians in relevant IT areas (Ajayi, 2003). The Enterprise Technology Centre (ETC) is one of such partnerships between NITDA and two private companies to provide IT training for Nigerian civil servants. Recently, NITDA is developing specialized software development training courses.

Public awareness: The Nigerian president has joined the battle – he is in the vanguard of the spread of e-society in Nigeria. Also, there is annually held conference in the country called *eNigeria* where inputs from Nigerian IT professionals in the Diaspora, local stakeholders are sought in the bid to take the country one step higher. NITDA also generate awareness of ICTs amongst Nigerians, which would fuel the engine of e-government in Nigeria, as they commissioned several buses called mobile internet units (MIU), these are locally manufactured buses moving from town to town, equipped with communication infrastructure such VSAT and computer terminals, disseminating e-government initiatives of the Nigerian government. See Figure 1 and 2 below. The MIU serve as awareness/campaign tool and utility tools. Additionally, NITDA has been involved with the development of a Nigerian Keyboard. This is perhaps an adaptation of technology for local use, which is considered vital in the success of e-government initiatives (Woherem, 1996; Gefen et al. 2002; InfoDev, 2004; Rupp, 2002; Udo and Edoho, 2000). Illiteracy is reported to be high in Nigeria (World Bank Group, 2004). A closer look of the phenomenon, may present a different perspective. A good number of these "illiterates", in English are in fact, literates in their own mother tongues; and in some cases in Arabic, for those that attended Koranic schools. The adapted keyboard provides an avenue for many more to participate in e-government, somewhat. With regard to generating critical mass for e-government in Nigeria, this particular NITDA's project would ensure that all citizens play a part in any emerging e-government programmes in the country.

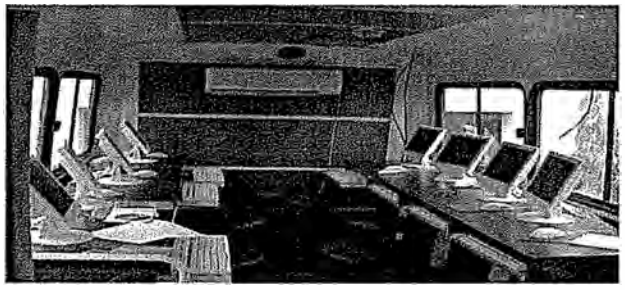

Figure 1. Mobile Internet Unit (MIU) **Figure 2. Inside the Mobile Internet Unit (MIU)**
Reproduced with permission from NITDA

Specifically, with respect of e-government practice in Nigeria, it is worth-noting that such is not widespread, nonetheless it is evolving fast. For example, the Federal government of Nigeria (http://www.nigeria.gov.ng/) and some states' (there are 36 states in Nigeria) governments operate web

portals, which are used for providing government information relating to official communications, laws, decrees and so on, to the public. On the hand, the ownership of web sites by about 800 local governments (LG) in Nigeria is almost a rarity. Thus, the diffusion of e-government at the nation's grassroots faces an uphill task as such a concept is virtually nonexistent. The level of services provided or obtainable from Nigerian e-governments' portals are categorised as belonging to Stage two(2) on the e-government practices model developed by Layne and Lee (2001), shown in Table 1. The original model represents the "stages of growth" model based on the experience of e-government practices for the USA. However, the model has been used to explain the status of e-government in other developing countries. On the model, the current e-government initiative in Nigeria, at the best, accommodates or facilitates "one-way service delivery" - Stage 2. See Table 1 for details. However, the transition to the third stage is already in motion (Ndukwe, 2003; Ajayi, 2003; Ajakaye and Kanu, 2004). So far, the Nigerian achievements and success stories relate to the on-going activities that could enhance the growth and diffusion of e-government in Nigeria, which we presented along external, organisational and technological contexts. At this juncture, we focus our discourse on areas in which more energy must be expended.

	Description	Practice	Main function
Stage 1	Government information delivery	Creating a website; putting the government information on the web	Providing information services for the public
Stage 2	One-way service delivery	Transforming some services to the websites; providing service passively, not exchanging information between governments and the public actively	Downloadable forms; administrative-focus for service provision; providing some operational services for the public
Stage 3	Two-way service delivery	Transforming more services on websites; supporting information exchanging between governments and the public	Services and forms on-line; simple interactivity between government and the public; changing to customer-focus service gradually
Stage 4	Complete e-government	Federal government, state governments, and local government sharing information via networks; and the provision of complex service to the public	Services and forms on-line; customer-focus service; integrating different functions; providing full functions for public interactivity; total and complete engagement

Table 1. Nigerian e-government phase (shaded) on a Four-Stage Model

4. AREAS DEMANDING SWIFT ACTIONS FOR E-GOVERNMENT DIFFUSION IN NIGERIA

In order for e-government to thrive and be sustained in Nigeria, the policy makers of the country would need to adequately address some of the following:

External environment –The political will that brought about the national IT policy needs to be sustained and re-invigorated. The sort of relapse seen with CCC may not augur well for the country in this new information age. Total focus on all the aspects (*eAdministration, eEducation* etc.) of e-society envisaged for Nigeria must be maintained. The unequal levels of absorption and pervasiveness of ICT within the country needs to be addressed. Importantly, efforts should be made to block the gap between the rural and urban dwellers with regard to e-government enablers such as access to the Internet, computer and electric power generation. Some of these issues may be of strategic relevance for the diffusion of e-government.

Awareness - The spread and the use of ICTs by Nigerians must be pursued vigorously. Campaigns may focus on explaining the importance of e-initiatives to the citizens. As the benefits become known to the populace, it is possible that the critical mass lagging is given a push. Wherever, an e-initiative, say *eHealthcare* or *eEducation* become operational, citizens must be encouraged to try such and left to ill-utilised such services. Thus, the policy and regulatory frameworks – covering legal and security issues - must be established. This will ultimately engender trust that could be useful in allaying the fears associated with the desire to have physical presence in dealings and transactions for which Africans have a liking for. Relatedly, the Nigerian government needs to intensify its awareness programme to focus on e-culture (one that is different from the traditional); namely, that commerce and governance can be done electronically. To bring about the sort of change that could promote the diffusion of e-government, swift actions are needed in this regard.

Attitudinal change – E-government, which is run by a government, does not mean it belongs to the government; rather it is for the citizens of any nation. Though e-government is an imported notion, it has the ability to provide tangible benefits to all countries – rich or poor (Heels, 1999; *Info*Dev, 2004; Layne and Lee, 2001; Cottrill, 2001; ASPA, 2003). This needs to be ingrained in minds of Nigerian public workers or those in power to manage e-government efforts. Ojo (1996) highlights this fact where he writes "During the colonial era, an average Nigerian worker had the notion that he is working for the "whiteman", rather than working for his nation ... there is a carry-over of this attitude into the post-colonial era, most especially in the public services." Change in the values of the Nigerian public worker, is crucial. Thus, the present initiative to train key government functionaries regarding the relevance of ICT in governance is most welcome. The promotion of co-operation among Nigerian ministries could reduce duplications of activities and so on. ICT and public service networks could enhance this endeavour. Ultimately, the Nigerian public sector could witness unseen efficiency and cost-effectiveness as a result of taking on board e-government initiatives. Such public service networks may curb corruption in governance due to the fact that data and information become accessible to more than one party.

Funding – In view of the fact that ICT are always imported, this limits the availability of such equipment to most parts of Africa, including Nigeria. This calls for prioritisation in allocating scarce resources. Wouldn't it be more beneficial for the Nigerian government to allocate sizeable amounts in national budgets to such pressing areas as the provision of ICT infrastructure to the nation than procurement of military hardware? The premise is that ICT could be used to boost productivity in areas such as education, health, agriculture and other areas. The current national IT policy has amongst its goals to use ICT for such purposes, but the resource allocation must be clear if such outcomes are to be realised and not turned into rhetoric. Furthermore, in light of the low critical mass regarding ICT use in Nigeria, the government could come to aid of small business (SMEs) regarding funding such entities for ICT products acquisition and training.

Infrastructural base – The Nigerian government needs to move swiftly on this front. Telephones lines are grossly inadequate; power generation for a country of 135 million is pathetic. The on-going effort to connect all the local governments in the country to the national grid is a positive step. About 660 out of the 774 local governments in Nigeria have been connected (Gukas, 2004). Likewise, the liberalisation of State monopoly in telecommunications must be sustained. More foreign investors should be wooed to further better Nigeria's teledensity (no. of telephone per 100 inhabitants), which jumped from 0.5 in 1999 to 2.5 in 2002 (Ajayi, 2003) and it is still improving. This achievement comes on the back of the liberalisation policy of that sector. Licensing ISP operators should continue to be granted as this will enhance the pervasiveness of the enablers of e-governance. However, the Nigerian must ensure that operators of telecommunications in the country further lower tariffs and spread to all corners of the country. Again, this will go along way in improving the pervasiveness, connectivity, absorption, and dispersion of ICT products that would engender the diffusion of e-governance.

Collaborations – The Nigerian government must be relentless in partnering with other regional governments as such partnerships could ensure that Africa gets a fair deal in technical and (even economic) matters. For example, the effort of South Africa with respect to the Internet governance agitation (Mutume, 2004; Nweke, 2004) on the continent needs the support of other regional players like Nigeria. In the same vein, partnerships with other local stakeholders (business) could be exploited with purpose of spreading ICT use and e-government initiatives. The Mauritian e-taxation was a partnership between the private

sector and the government. The on-going effort in Nigeria involving private IT multinationals and NITDA in providing IT skills, is an example worthy of note.

Education and technical infrastructure – The government should redouble its effort at providing the sorts of skills needed for implementing and sustaining e-government. At this present point in time, the required level of human skills in the country is incommensurate with its size (Ojo, 1996; Woherem, 1996). More IT training and literacy programmes must be initiated in order to facilitate reasonable levels of sophistication of use for any emerging e-government initiative. Such training could even be in local languages (e-government need not be in English). More so, local governments (LG) need to be sensitized about the import of e-government. The current statistics with regard to the diffusion of e-government in Nigerian LG is not encouraging. The Federal government of Nigeria should open up this front.

5. SINKING IS NOT AN OPTION

Though e-government is an imported notion, which when properly deployed in the Nigerian society can help bring about a change. Avgerou (1998) cited Castells and Henderson and writes that "At the present, most DC are severely disadvantaged within a global economy which is increasing more technology and information intensive: Unequal distribution of resources, such as telecommunication and technical skills, causes concern about the ability of developing countries to participate in emerging world economy." Arguably, e-government initiatives in Nigeria and elsewhere in the DC arguably can help redress the imbalance or at least provide an opening for "catching up". Delays and complacency on the part of policy-makers elsewhere in Africa and in Nigeria in particular will only affirm the observation "reinforce[ing] historical patterns of inequality" (Heeks, 2002). This viewpoint is not dissimilar with those of the late President of Ivory Coast – F. Houphouet-Boigny – in his comments that "after, having missed the industrial revolution, Africa should not once more miss the computer revolution." He continues: "countries that neglect this domain in their development process are increasingly widening the gap between themselves and the developed countries, who will find in this a new reason to exercise more monopoly over power" (Maombe-Neko, 1996, 67). Sadly, Dutta et al.'s (2003) Global Technology Report compared 82 countries using data from International Telecommunications Union (ITU, 2004) and The World Bank on the readiness for a network world. Nigeria fared woefully, sinking to the bottom consistently on most of the indicators used. For example, Nigeria ranked 55$^{th.}$ on the level of sophistication of local buyers' product and services; 78$^{th.}$ on the availability of mobile internet users; 81$^{st.}$ on the availability of public access to the internet; 77$^{th.}$ on adult literacy; 80$^{th.}$ on secondary school enrolment scale; 82$^{nd.}$ on both the cost of local call and cost of residential phone subscription. The relative poor position of Nigeria on ASPA's (2003) e-government benchmarking index is another. Nigeria must make concerted effort in using information and communication technologies in uplifting its citizens from the abyss of inadequacies (Sachs and Warner, 1997; Molla, 2000). E-society and e-government initiatives are ways by which this could be realised. In this paper, we discussed the benefits of such an exercise. Certainly, sinking to the bottom of all indicators for a nation like Nigeria - as gleaned from the statistics above - is not an option. Rather, the policy-makers in Nigeria should heed the call of Houphouet-Boigny by incorporating ICTs into governance as well as promoting programmes and schemes that engender the diffusion, adoption, adaptation and use of such technologies against the backdrop of a changing or changed world.

6. IMPLICATIONS AND CONCLUSION

This paper has investigated the problems, practices, benefits and growth of e-government in the context of Nigeria. It is not claimed, in this article, that e-government possesses the Magic Wand to transform the Nigerian society into a Utopian one; rather, we believe that the march towards socio-economic competitiveness and better governance could arise from an e-society where e-governance is valued and promoted. The external, organisational and technological contextual factors regarding the notion of e-government must be clearly evaluated as Nigeria matches forward in the 21$^{st.}$ Century. To that end, this paper essentially aims to fuel further discussions by deliberating some of those factors. Also, the paper provides some suggestions as to where effort must be exerted as Nigeria contemplates adopting e-society and e-government (see, Obasanjo, 2003; Ifinedo, 2004). The competitiveness of Nigeria in an increasing "networked economy" may not be pleasant if Nigerian policy makers fail to wake up to the reality on the ground. Importantly, efforts need to be made at redressing the poor statistics or indicators for the Nigerian State within the networked world in which e-society (and e-government) notions dominate. Thus, the implication for human resource development for Nigeria is that ICT when properly harnessed for an

exercise such as e-government could help bring about change - or serve as an engine for growth - which may be useful for enhancing efficient governance, wealth creation, job creation, global competitiveness, and above all engender societal transformation. Future empirical studies could investigate the relevance of the e-government awareness campaigns in the country and the perception of the citizens towards the available services in the country.

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The Role Of IT In Supporting Women Entrepreneurs In Urban Tanzania

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ABSTRACT

The purpose of this study is to analyse the role of IT in supporting women entrepreneurs in urban Tanzania. Based on interviews with women entrepreneurs in the cities of Dar es Salaam and Arusha, we found that women entrepreneurs in urban Tanzania have started using this new technology to improve their businesses. Most of them are using email and Internet services to communicate with their business partners and friends. Internet services are also being used to search for product related information. Several positive effects from using IT were reported, such as increased sales, access to new customers and markets, and improved efficiency of operations. For example, women running garment related businesses used the Internet to search for new designs for women's clothes, thus enabling them to improve their products and enter foreign markets in the neighbouring country of Kenya. Lack of financial resources and lack of computer skills were reported as the major barriers for accessing IT services, while language barriers and lack of time only were mentioned by a few of the women entrepreneurs. However, lack of time was also stated as a barrier to achieving the needed training, thus also having an indirect negative effect on IT adoption and use. These results indicate that providing funding schemes and access to IT training programs are of key importance for stimulating human resource development through further adoption and use of IT services among women entrepreneurs in Tanzania.

1. INTRODUCTION

Governments world-wide recognise the importance of small businesses and their contribution to economic growth, social cohesion, employment, and regional and local development (OECD, 2004). As globalisation and technological change reduce the importance of economies of scale in many activities, the potential contribution of smaller firms is enhanced. However, many of the traditional problems facing small businesses - lack of financing, difficulties in exploiting technology, constrained managerial capabilities, low productivity, and regulatory burdens - become more acute in a globalised environment (ibid.).

Information technology (IT) is playing an important role in economic and social development. Research on IT and development has found that without incorporating IT in development plans, there is little chance for countries or regions to develop (Hafkin and Taggart, 2001; UNCTAD, 2002).

The use of IT has made it possible to accumulate and access different information and data sources. Therefore, access to IT is important for any development process. As the access to and use of IT is directly linked to social and economic development, it is therefore important to ensure that all groups of the population, including women, understand the significance of these technologies and use them (Hafkin and Taggart, 2001). Since women constitute a significant part of the workforce in most economies (United Nations, 2004), they should have access to national and world-wide information exchange forums that will enable them to share ideas, proposals, documents and information (APC, 2005).

Women entrepreneurs globally have stated that access to information, especially market information, is their first priority in accelerating the growth of their businesses. The major information needs of small businesses in developing countries are for information about supply (obtaining inputs), demand (new and existing customers), finance (business management and obtaining additional finance), the environment in which they are doing business, and skills (Hafkin and Taggart, 2001). It is assumed that IT could work well for women entrepreneurs, who in many developing countries account for the majority of owners of small, medium and micro enterprises, as it allows them to save time and costs while trying to reach out to existing and new customers.

However, lack of knowledge and access to business information has made women in small-scale businesses unable to compete with other established businesses worldwide. Among the reasons is that in developing economies, most of the women operate along traditional ways of organising production and marketing. Due to this pertinent feature, business information that comprises knowledge of suppliers and customers, competitors and business partners, as well as of technical and managerial aspects of business operation, and of relevant qualities of the business environment such as laws and regulations, is largely not available (Kristiansen, 2001).

Studies have also shown that getting reliable statistics on women's use of IT in developing countries is difficult. A study by Hafkin and Taggart (2001) shows that in many developing countries, less than one percent of the population has Internet access. By regions, women constitute 22% of all Internet users in Asia, 38% in Latin America, 6% in Middle East, but there were no regional figures of Internet users by gender in Africa. Another study by UNCTAD (2002) revealed that there is very little research and documentation on the impact of IT and e-commerce on women in developing countries. And whatever data and statistics exist, they are often not disaggregated by gender. The gender gap in the digital divide is of increasing concern because women within developing countries are in the deepest part of the divide, than are the men whose poverty they share (Hafkin and Taggart, 2001). Thus, there is a great need for empirical studies on the use of IT among women in developing countries.

The purpose of the study reported in this article is to analyse the role of IT in supporting women entrepreneurs in urban Tanzania. Despite the many benefits accruing from the use and application of IT in entrepreneurship growth and development, there is little deployment or access to such technologies in this country, especially in the rural areas (Tanzania Ministry of Communications and Transport, 2003). In Tanzania as in many developing countries, the IT industry is still in an early stage. IT users in Tanzania are mainly found in urban areas, where this technology is accessed through Internet cafés such as in Dar es Salaam, the commercial and administrative capital, and Arusha, the tourist capital of the country (Nielinger, 2003). By year 2002, there were 23 licensed Internet Service providers, providing between 10,000 and 15,000 dial-up accounts in the country, with an additional number of users via companies, government LANs, and Internet cafés (ibid.).

One of the emerging features of IT in Tanzania is the involvement of women entrepreneurs in this new industry. Women entrepreneurs are increasingly establishing new businesses in this industry, such as Internet cafés and computer training centers, and are also using IT services to improve their businesses. Also, women in other industries such as the garment business use IT services to improve their products and enter new markets. Overall, it is estimated that about a third of the GDP in Tanzania originates from small and medium sized enterprises (SMEs), with micro enterprises (1-4 employees) operating in the informal sector alone consisting of more than 1,7 million businesses engaging about 3 million persons, i.e. about 20 % of the Tanzanian labour force (Tanzania Ministry of Industry and Trade, 2002).

We interviewed 25 women entrepreneurs owning small businesses in the cities of Arusha and Dar es Salaam, focusing on their use (or non-use) of IT services for supporting their business, and perceived barriers in the adoption and utilisation of IT services. We found that most of these women were using IT services for improving their business, such as searching for information on the Internet and communicating with business partners through email. This was stated to result in positive effects such as increased sales, access to new customers and markets, and improved efficiency of operations. Lack of financial resources and lack of computer skills were reported as major barriers for accessing IT services.

The paper is structured as follows: Section 2 presents an overview of relevant literature, and section 3 describes the research methodology. Section 4 presents and discusses the results from the data analysis, and section 5 provides conclusions and implications.

2. LITERATURE REVIEW

In this section we briefly review relevant literature in three areas: women entrepreneurs, IT and developing countries, and women's acccess to IT.

2.1 Women Entrepreneurs

Entrepreneurship offers tremendous opportunities for women across the world by opening doors to greater self-sufficiency, self-esteem, education, and growth – not only for the women themselves, but also for their

families and their employees (Jalbert, 2000). Women-owned businesses have become a significant part of the small businesses world-wide, and their influence continues to grow. According to the Centre for Women's Business Research, in U.S. women now own over 50% of all privately held businesses (NFWBO, 2004). In developed countries in general, women own more than 25% of all businesses. It has also been observed that self-employed women are contributing in significant ways to economic health and competitiveness in countries around the world. For example, women produce more than 80 percent of the food for Sub-Saharan Africa, 50-60 percent for Asia, 26 percent for the Caribbean, 34 percent for North Africa and the Middle East, and more than 30 percent for Latin America (ibid.).

Although male and female entrepreneurs possess many similarities, women's motivations for starting a business can be different from male entrepreneurs. Women start their own businesses for a variety of reasons. According to DeMartino and Barbato (2002), women entrepreneurs are not equally motivated by wealth creation and advancement reasons, as their male counterparts. Buttner (1993) found that women are influenced and motivated more by family needs compared to men who are motivated by economic motives. Also, Brush (1992) argues that most of the women are motivated to a much larger extent to create businesses that allow flexibility to balance work and family. It has also been observed that a higher proportion of women are motivated by dissatisfaction with their current employment and view business ownership as a job alternative that is more compatible with other aspects of their life (ibid.). Therefore, entrepreneurship as a career can offer a degree of flexibility and balance that many other careers do not offer, i.e. flexibility and the ability to balance work with relationships and family.

2.2 Information Technology Opportunities for Developing Countries

The potential benefits for developing countries from adoption and use of IT is highly focused and documented. By using technology to access worldwide demand, businesses in developing countries can operate on a larger, more efficient scale, and then become more competitive with firms in industrialized countries. Even small businesses can expand their activities; for example, a small business that serves a single niche market in a developing country can increase its size by using communication technologies like the Internet to identify similar niche markets in other countries (Hafkin and Taggart, 2001).

Small and medium-sized firms in developing countries can also use networking technologies to partner with the growing number of multinational firms that outsource many activities to third world countries. Or, alternatively, they can use communication networks to link their operations together, allowing them to function and compete as if they were much larger entities (Alkadi et al., 2003). Equally important, developing countries' businesses, by operating globally, will have access to greater financial resources and opportunities for technology transfer (Sheats, 2000). In addition to providing owners of small businesses with possibilities for accessing information to facilitate their business, and generating and disseminating information about it (op.cit.), IT also improves business process efficiency and productivity by reducing operational costs, and decreasing material, procurement and transaction costs, thus resulting in lower prices for intermediate and finished goods (UNDP, 2001).

The range of women's economic activities in developing countries is very broad. It includes formal sector and informal sector employment, as well as self-employment in farming (particularly in Africa), trading, and crafts production. Increasing numbers of women entrepreneurs run small- and medium-scale enterprises. There are numerous possibilities for IT to improve women's economic activities in these areas, and in all of them increased access to information is probably the greatest benefit that IT can bring (Hafkin and Taggart, 2001). Information technology provides also a number of unique opportunities for women in developing countries. In farming for example, with the paucity of information resources available to rural women farmers, IT (the fastest and cheapest means of information exchange) has great potential to help meet the needs of rural women farmers and to benefit rural communities. Timely access to market information via communications networks will help these women make decisions about what crops to plant and where to sell their products and buy inputs (UNDP, 2001). Use of IT also can provide up-to-date information on markets to producers, thus increasing their bargaining power (Bhatnagar, 2000).

However, despite the promising opportunites offered by IT for generating new business, empirical evidence shows how the expected potential from IT may be difficult to realize, resulting in limited impact. For example, a study of the garment and horticulture sectors in Bangladesh, Kenya, and South Africa, showed that very little business with new firms was being generated by using Internet-based, business-to-business (B2B) e-commerce (Humphrey et al., 2003). Instead, the main effect of e-commerce was to enhance the relationships between existing partners, and reducing communication costs through email.

Among the factors limiting the use of Internet services were inadequate and costly domestic telecommunication infrastructures and slow connection speeds.

2.3 Factors Necessary for Women's Access to Information Technology

Information technology holds the promise of enabling unlimited access to information irrespective of a person's social situation. The following factors have been found to affect women's access to IT: education, language, financial resources, cost, location, culture, and skills (Hafkin and Taggart, 2001; UNCTAD, 2002).

The most important factor in order for everyone to access IT is basic education in how to read and write, e.g. in order to read and compose simple messages on the computer, and navigate the Internet. Since most of the women in developing countries are illiterate, they are more likely than men to lack basic computer skills, which would enable them to take advantage of the new global communication opportunities. In order to use more sophisticated IT applications, women need computer knowledge on specific computer programmes. Therefore, gaining sufficient skills for application of IT is one of the important determinants of women's chances for equal participation in IT (Hafkin and Taggart, 2001).

Another important factor for accessing IT is language. This is important because the most used language in computer programmes is English. Not all countries have managed to translate the computer language into different local languages. Therefore, the use of English language tends to exclude access to the majority of the world's population who speak other languages. This factor significantly impacts women and other marginalized groups who do not have formal schooling that would allow them to learn international languages. Hafkin and Taggart (2001) argue that the Internet's present English language dominance demonstrates the heavy flow of information from the U.S. and Western Europe to developing countries, and makes an exchange of information between the non-elites in the two spheres very difficult.

In order to use IT, one needs to have either one's own personal computer or access to an Internet café. Private, home-based use of computers and Internet is currently available only to educated people in developing countries. In this respect, small business entrepreneurs need sufficient capital in order to deploy IT benefits for supporting their businesses. However, the truth of the matter is that, for most women, the source of the necessary financial capital is the micro credit schemes or special institutions in developing countries that lend specifically to women who have no collateral, and who work mostly in the informal sector (UNCTAD, 2002). Therefore, one needs to have enough capital to buy a personal computer or to buy services from an Internet café.

The geographic location of public Internet centers is another important factor that affects women's access to IT in developing countries. It is argued that women's mobility is considerably more limited than men's in most societies. This mobility may be further limited in conservative societies where religious or social customs do not permit women to go in public without male supervision. Where public Internet cafés are located at a great distance from residential communities, women are less likely to visit them (Hafkin and Taggart, 2001).

Women's ability to access IT is also shaped largely by socio-cultural norms that determine female behaviour and interests. As mentioned in the above section, in culturally conservative societies, women are often not allowed to go without supervision to public venues where men are present. Moreover, women may be uncomfortable frequenting a cybercafé with predominantly male users, or seeking help from male staff. Cultural norms discourage interaction between women and men outside their family. This is especially pertinent in Africa and in the Islamic world (ibid).

3. RESEARCH METHODOLOGY

As discussed in the previous section, there is yet limited research on the adoption and use of IT among women in developing countries. Thus, our study was of an exploratory nature (Yin, 1994). We chose a qualitative approach for being able to collect contextual data related to the phenomenon in focus (Strauss and Corbin, 1990). During July 2003, semi-structured interviews were conducted with 25 women entrepreneurs in the cities of Arusha (15 interviews) and Dar es Salaam (10 interviews). These women entrepreneurs were selected through snowball sampling (Miles and Huberman, 1994), as it was not possible to get the list of all women entrepreneurs through the municipality council office. The interviews lasted about 30 minutes each, and were conducted at the respondents' place of business, allowing the interviewees

to express themselves freely regarding their use (or non-use) of IT services, and its impact on their businesses. A semi-structured interview guide was used, consisting of several open-ended questions covering the following areas: personal particulars of women entrepreneurs, background before starting the business, initial capital, performance of the business in terms of sales revenue and profits, use of IT services, the effects of using IT in their businesses, and obstacles encountered in business and in accessing IT services. Other secondary sources were also used, like Tanzanian ICT policy documents.

The interviews were transcribed and categorized into a set of factors related to the adoption and use of IT services among the women entrepreneurs, and the effects from this on their businesses.

4. RESULTS

In this section we present and discuss the results from our study. These are organized under four areas: the profile of the women entrepreneurs interviewed, characteristics of their businesses, their use of IT services, and perceived barriers to accessing IT services.

4.1 Profile of Women Entrepreneurs

Table 1 presents profile data of the women entrepreneurs. The age of the women entrepreneurs ranged from 23 to 55 years, with median of 40 years. Most of the women interviewed were married. Fifty-six percent of the respondents had been previously employed before starting their own businesses. This can be related to the educational level of these women entrepreneurs, as the majority (52 %) had above form-four education level, i.e. they had specific professional and/or academic skills acquired in colleges or universities.

Table 1. Profile of Women Entrepreneurs

Parameters	***Results [N=25]***
Age (median)	40 years
Marital status	Married: 18 (72%) Single: 7 (28%)
Education	
- Standard Seven	3 (12%)
- Form Four	9 (36%)
- College education	8 (32%)
- University education	5 (20%)
Previous work experience	
- Previously employed	14 (56%)
- Not previously employed	11 (44%)

4.2 Business Characteristics

Table 2 presents an overview of characteristics of the businesses of the women entrepreneurs interviewed. A dominant and frequently mentioned characteristic of women owned businesses is that they are small in size, as measured by the number of employees (UNCTAD, 2002). This was confirmed in this study, where the majority of the women's enterprises (68 %) had less than 5 employees, and an average of 3 employees. The largest businesses in this interview sample was a computer company with 12 employees, and a business making batik die and sweaters with 10 employees. The number of years since startup of the business ranged from 1 to 30, with 8 years as the median. The businesses studied fall under three categories: Garment related businesses; IT related businesses; and other businesses (for example hair dressing salon, making dry flowers, and handicraft activities). Of these, we mainly targeted garment related businesses, as this is a typical women's enterprise in Tanzania (e.g. making batik or sewing women's clothes). In addition, IT related businesses represent a new industry in Tanzania, and the businesses in this category in our interview sample included Internet cafés, computer training centres, a computer company,

and a business offering photocopy and secretarial services. The purpose was to study the use of IT services among women entrepreneurs within these two industries.

The study shows that the women entrepreneurs have a limited market penetration, usually confined to their local areas (92%). Only a few of the women entrepreneurs had managed to enter international markets (12%), for example in the neighbouring country of Kenya. These women were running garment related businesses (making batik and sewing sweaters for primary school pupils).

It was also revealed that the majority of the women (68%) obtained the initial funding required for starting their business from personal or family savings. Only 8% of the women had acquired their initial capital through bank and microfinance institutions, such as PRIDE (Promoting of Rural Initiatives and Development Enterprises) and SEDA (Small Enterprises Development Agency). The remaining women had obtained their capital through other sources like loan from friends.

Table 2. Business Characteristics

Parameters	Arusha [N=15]	Dar es Salaam [N=10]	Results total
Average number of employees			3
Length of time operating business (median)			8 years
Type of business			
- Garment related businesses	7	5	48%
- IT related businesses	4	3	28%
- Other businesses	4	2	24%
Markets			
- Local markets	13	10	92%
- Outside the city	6	-	24%
- International markets	3	-	12%
Start-up capital			
- Own or family savings	10	7	68%
- Bank loan	1	-	4%
- Micro finance institutions	1	-	4%
- Other sources	3	3	24%
Business performance			
Sales per month - Average			500,000 Tshs.*
Profit per month - Average			100,000 Tshs.*

*US $ 1 = Tshs. 1,126 (by 22nd May 2004, rates from NBC: http://www.nbctz.com/)

Sales revenues varied greatly among the businesses studied, ranging from Tshs. 100,000 to Tshs. 4,000,000 per month (US $ 88 to US $ 3,552). The majority (36%) had earned income which ranged from Tshs. 500,000 to 1,000,000, while 33% had earned income less than Tshs. 100,000. Twenty percent had earned income above Tshs 1.5 millions per month. Regarding business profits, the majority of the women earned profits within a range from Tshs. 100,000 to 300,000 per month, with the lowest profit being Tshs. 70,000 per month and the highest profit being Tshs. 550,000 per month. Thus, the variance in profits was big, although not as big as for sales revenues.

4.3 Use of IT Services

Table 3 provides an overview of the overall use of IT among the women entrepreneurs interviewed, both in general and related to the start up process of their business.

Table 3. Use of IT services

Parameters	Arusha [N=15]	Dar es Salaam [N=10]	Results total
Use of any IT services?	15	4	76 %
Use of IT in start up process?	3	1	16 %

An increasing number of women in Tanzania are taking advantage of IT services. Some of them have started IT related businesses, and some are using IT services to improve their business performance. In this study, 76% of the women interviewed were using IT services. The nature of these services is reported in Table 4. The higher proportion of IT users in the Arusha interview sample compared to the Dar es Salaam sample can be explained by the snowball sampling strategy applied for selecting women entrepreneurs. In Dar es Salaam, the first women entrepreneur interviewed was a non IT user, and thus less capable of referring to other women entrepreneurs using IT.

Only 16 % report having used IT services during the start up process of their business. Among these, examples of IT use include searching for information on raw materials and equipment (e.g. computers for Internet café, and washing machines for dry cleaner). Possible causes for the low usage of IT during start up are discussed in the next section, related to barriers to accessing IT services.

Table 4 summarizes characteristics related to the access and use of IT services among the women entrepreneurs currently using IT.

Table 4. Characteristics of IT Use Among Women Entrepreneurs

Parameters	Arusha [N=15]	Dar es Salaam [N=4]	Results total
Access to IT Services			
- Own computer	5	4	47%
- Internet café	10	-	53%
Purpose of using IT services			
- Email only	1	-	5%
- Word processing only	-	1	5%
- Email and Internet	7	-	37%
- Email, Internet and word processing	7	3	53%
Type of information accessed			
- Business related information	11	3	74%
- Other information	4	1	26%
Communication with			
- Customers/suppliers/partners	5	2	37%
- Friends and family	4	-	21%
- Both	6	2	42%
Effects of using IT*			
Sales increase	11	2	68%
Access to new customers	8	-	42%
More efficient operations	9	2	58%
Cost reduction	2	-	11%

*This shows the responses to an open ended question on the perceived effects of using IT. One respondent could state multiple effects.

The majority of the women interviewed access IT services through Internet cafés (53%), while others have their own computers at their respective businesses' premises. All except one of the women who had their own personal computer, also had Internet connection. The purpose of using IT services was stated as to send email, to search for information, and/or for using word processing. Fifty-three percent of the

women using IT reported using all three of these services. The respondent who had a computer without Internet connection used this for word processing only. The majority (74%) of the women reported using IT services for searching business related information (product information, customers/suppliers information), while the rest were searching non-business related information such as news services. Email services were used both for communicating with customers, suppliers and business partners, and with friends and family.

The costs incurred for accessing IT services ranged from Tshs. 1,000 to 30,000 per month, with the majority spending between 20,000 and 30,000 Tshs. per month. Concerning the impact of using IT services, the women were asked to express themselves on how IT has affected their businesses. A majority of the women using IT services reported one or more positive effects in the form of sales increase, access to new customers, and/or more efficient operations. Access to product-related information (e.g. new product designs) through the Internet was most frequently stated as the cause for increased sales and attracting new customers through product improvement. For example, some of the women who were running garment related businesses described how they were able to access new designs on the Internet. This helped them to improve their products, and they were able to sell their products in Nairobi. As stated by one of these women:

> "*By using Internet, I am able to get access to new designs for ladies' suits and dresses. This has helped me to get more customers, which in turn have increased the sales revenues*". (WE 11, Arusha)

Only two of the women explicitly stated that they were able to reduce operations costs by using IT services, as exemplified by the following statement:

> *"The Internet has helped me to reduce transactions costs, as I know where to get spare parts for production equipments"*. (WE 1, Arusha)

Some women also reported how using email services to communicate with their business partners instead of travelling to their place of business was cheaper and time saving. Our data does not allow for identifying causal relationships between IT spenditure and business performance, as the nature and extent of IT use varies between the different types of businesses. Also, several of the interviewees were unwilling to report their monthly profits. However, the qualitative data indicates that the perceived positive effects from using IT services was similar across the different types of businesses studied.

4.4 Barriers to Accessing Information Technology

One of the objectives of this study was to identify the obstacles encountered by women entrepreneurs in accessing IT. The most frequently mentioned barriers were cost, knowledge and skills of how to use a computer, language, and time. These factors have also been documented in former studies (e.g., Hafkin and Taggart, 2001; UNCTAD, 2002).

As indicated in the literature review (Section 2.3), one major factor affecting women's access to IT is financial resources. This is also confirmed in this study, where 64% of the women interviewed mentioned this factor as one of the major obstacles. Most of these women do not have enough capital to exploit IT opportunities, like having their own computer with Internet connection and promoting their business through the Internet. As stated by one of the respondents:

> "The major problem is capital, not IT itself, because anyone with money can access and use this technology. If you have money you can be trained how to use a computer, you can buy your own computer and connect it to the Internet". *(WE 6, Dar es Salaam)*

When asked if she had considered taking a loan from a bank or micro credit institution, the same woman replied:

"I wanted to take a loan from a bank, but the interest rate is too high, and the payback period is too short. Therefore, I realised that I can't pay back the loan within such a short period". *(WE 6, Dar es Salaam)*

The high interest rate is not only the case of banks, but also for most microfinance institutions in Tanzania. For example, loans from SEDA (Small Enterprise Development Agency) carry a 30% flat interest rate and 3% one-time commission, and loan terms are typically for six months. All loans need to be guaranteed with a 20% cash deposit before a loan can be disbursed. Repayment is done on a weekly basis (EDIAIS, 2001). These interest rates and loan terms apply to most of the micro credit institutions in Tanzania. However, not all women who are running small businesses can generate quick cash flows that will enable them to repay the loan within six months or one year.

Another obstacle mentioned was lack of specific knowledge and skills on how to use a computer. Thirty-six percent of the women interviewed regarded this factor as an obstacle. These were mainly conjunct with the women reporting not using any IT services today (see Table 3).

Only 12% of the interviewed women mentioned language as a barrier to accessing IT services. This rather low figure reflects the relatively high educational level of these women (see Table 2), compared to the general level of education among women in Tanzania. According to the Household Budget Survey conducted in 2000/2001, 53.8% of all women in mainland Tanzania (i.e. not including Zanzibar) had only primary education (NBS, 2001). The dominance of the English language is thus a problem to most women in Tanzania. In the primary education system the Swahili language is the medium of instruction, while English is a compulsory subject.

In the literature review (Section 2.3), lack of time was discussed among the reasons why women do not access IT services. A major reason for this lack of time is that women have so many family responsibilities. However, in this study only 16% of the women mentioned this factor. These women stated that they did not have enough time to learn how to use a computer, since they need to be trained how to execute commands on the computer, and navigate the Internet. As stated by one respondent who ran a garment related business:

> "*Currently, I am using IT services, but I am not good enough to fully exploit IT opportunities. I need to be trained, but I do not have enough time for computer training*". (WE 9, Arusha)

This statement indicates how lack of time may have a negative influence on the possibility for acquiring the necessary training, thus acting as a barrier towards adoption and use of IT services.

5. CONCLUSIONS AND IMPLICATIONS

The overall objective of this study was to analyse the role of IT in supporting women entrepreneurs in Tanzania. The study focused specifically on the use of IT services and its impact on business performance, and perceived barriers to using IT services. A majority of the women entrepreneurs interviewed in this study are using this new technology to improve their businesses, by searching the Internet for business-related information and/or communicating with customers, suppliers and partners through email. For example, the study has shown that women who are running garment related businesses are searching for new designs for women's clothes through the Internet. Several positive effects from using IT were reported, such as increased sales, access to new customers and markets, and improved efficiency of operations.

The study has also shown that women entrepreneurs face several barriers to accessing IT services. The major problems mentioned in this study were lack of financial resources, and lack of computer skills. Language barriers and lack of time were only mentioned by a few of the women entrepreneurs. However, lack of time was also stated as a barrier to achieving training, thus having an indirect negative effect on IT adoption and use.

To enhance women's capacity to become full members of the new information economy, the following aspects are relevant. The government can promote business and entrepreneurial prospects for women by offering financial capital and micro financing to women entrepreneurs in order for them to fully exploit the opportunities offered by IT services. Women entrepreneurs can also be sponsored to attend IT-related courses to obtain specific knowledge on the use of computers. Governments or other non-governmental institutions can run specific courses, and charge affordable fees for women. The most

important in this training is to ensure that women acquire the right IT skills. Women will also need business and entrepreneurial skills in order to apply these IT skills: if they are to use IT in managing their small businesses, they need to be trained in how to develop business plans, conduct market surveys, and search for sources of funding and market information. Improved accessibility to training for women entrepreneurs in both IT- and business-related skills thus stands out as a critical requirement for enhanced human resource development in developing countries like Tanzania.

Tanzania is a less urbanised country and therefore most women live in rural areas. Currently, however, IT services in Tanzania are accessible only in the major cities. Therefore, for women to gain access to IT, the government needs to increase availability of such technologies in the areas where most women live. In this respect, extension of infrastructure, particularly in rural areas and peri-urban areas, is crucial to increasing women's access to information technology.

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Generalisations from an Interpretive Study: The Case of a South African Community-Based Health Information System

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ABSTRACT

This paper explores the making of generalisations from interpretive research by examining the process of developing a community-based information system (IS) in a rural area in South Africa. Baskerville and Lee's (1999) framework of four categories, and Walsham's four types of generalisations form a framework that is used in this case study. The generalisations made include the reconceptualisation of participation and the development of a communication framework which extends Habermas' criteria for the 'Ideal Speech Situation'. The main argument of this paper, using the generalisations made from this single case study, is that generalisations from interpretive research can be made and that much valuable contribution in the IS field is lost because IS researchers fail to make these generalisations. Though, we conclude that there is no set recipe or methodologies for the development of a community-based IS, the human resource development of researchers can use the generalisations made and the documentation of such rich experiences to orient themselves to the necessary competencies to conduct similar work.

INTRODUCTION

Information Systems (IS) researchers have identified generalisations of results from interpretive case studies to be a significant challenge (Lee and Baskerville, 2003; Walsham 1995). The challenge of generalisations concerns how results from a particular case study, whether in terms of methodologies adopted or theoretical insights generated, can be abstracted, and applied to, other settings. Unlike positivist studies which rely on statistical generalisations (Baskerville, 1996), interpretive research poses different sets of challenges around generalisations, especially relating to what can be generalised, how and to what extent. This paper seeks to address some of these questions in the context of an empirical analysis of the design, development and implementation of a community-based health IS in one health district of South Africa. The research challenge concerns analysing what aspects of the research process and outputs can be generalised to the introduction of similar systems in other health districts of South Africa and to other IS related research settings. Implications are also developed around human resource issues, specifically with respect to how capacity can be enhanced to conduct similar research in other settings.

One of the reasons as to why generalisations are not typically made from interpretive research is that generalisations are often narrowly, and arguably inappropriately, confined to a positivist view of research. Positivist studies generally adopt statistical-based approaches to develop mathematical relationships between independent and dependent variables, and extrapolate the results from the sample studied to the larger population within specified statistical confidence intervals (Baskerville, 1996, p5). Interpretive research has been criticised from this perspective for its results being "non-generalisable" to larger populations because its focus is "only" on a single case study or "only" one organisation (Baskerville and Lee, 1999, p3). Such an interpretation of generalisations is worth challenging from both a theoretical and empirical perspective. The aim of this paper is to argue that both empirical and theoretical generalisations from interpretive case studies are both necessary and possible, however, they require approaches different from those used in positivist studies.

The paper is accordingly structured in the following manner. In the next section a perspective of generalisations, broader than the usual positivist approach noted above, is given and its application to the IS field is discussed. To practically illustrate the argument made for the development of generalisations from

single interpretive case studies, the next section explores the research process involved in such a case study. In the following section, the discussion focuses on the specific generalisations that can be made from that case study. In conclusion, we discuss certain implications for human resources capacity development.

GENERALISATIONS AND INTERPRETIVE IS RESEARCH

Various debates exist over the question of the development of generalisations from interpretive research. These vary from "If there is a 'true' generalisation, it is that there can be no generalisation" (Lincoln and Guba, 1985, p110), to Baskerville and Lee's call for interpretive researchers to acknowledge the generalities of their work (Baskerville and Lee, 1999). Much of this debate stems from the definition of generalisations used and varies with the epistemological approach of the researcher. Guba and Lincoln describe generalisations as ".... assertions of enduring value that are context-free. Their value lies in their ability to modulate efforts at prediction and control." (Lincoln and Guba, 1985, p111) While not completely agreeing to the appropriateness of making generalisations from interpretive/qualitative case studies, they argue however about the need to develop "working hypothesis" which represent tentative assertions of the situation, which are uncovered and tentatively applicable to other situations. The transferability, however, depends on the similarities between the contexts referred to by Guba and Lincoln as 'fittingness'. The concept of "working hypothesis" resonates with Geertz's notion of "thick descriptions" of a particular phenomenon within a specific context (Geertz, 1973). Another researcher who in reading the "thick description" can interpret similarities and differences between different contexts, and the level at which abstractions can be made about applying generalised learning from one context to another.

Lee and Baskerville (Lee and Baskerville, 2003) provide a comprehensive review of generalisations in the IS field, and build upon the work of other IS researchers who advocate the need to develop generalisations from interpretive case studies (Walsham, 1995). After exploring the philosophical foundations of different forms of generalisations, namely the positivist and interpretivist schools, Lee and Baskerville develop a framework of four different types of generalisations. They distinguish between the base from which the generalisation is being made, either empirical or theoretical, and the base to which the generalisation is being applied, again either empirical or theoretical. The four types of generalisations are thus empirical to empirical; empirical to theoretical; theoretical to empirical, and; theoretical to theoretical (Lee and Baskerville, 2003).

Drawing from Bhaskar's concept of generative mechanisms (Bhasker, 1979), Walsham extends the notion of generalisations from interpretive case studies. Generalisations can best be viewed, according to Walsham, as 'tendencies' and are best "... seen as explanations of particular phenomena derived from empirical interpretive research in specific IS settings, which may be valuable in the future in other organisations and contexts." (Walsham, 1995, p79). Walsham outlines four types of generalisations from interpretive case studies: the development of concepts, the drawing of specific implications, the contribution of rich insight and the generation of theory. Integrating the idea of Lee and Baskerville (Lee and Baskerville, 2003) and Walsham (Walsham, 1995) helps to develop a framework around the "categories" and "types" of generalisations. This framework is presented in Table 1 below and then examples are provided.

Types of generalisations	**Category of generalisation**	
	Empirical to empirical	**Empirical to theoretical**
Developing concepts	Developing single concepts or concepts as part of a broader network.	
Drawing specific implications	Drawing specific implications from particular case studies or research settings.	
Contributing rich insight	Insights that are neither concepts nor specific implications of theories.	
Generating theory		Generalisability of measurements, observations, concepts or other descriptions to theory.

Table 1: Category and types of generalisations

Empirical to empirical:

Generalising from empirical to empirical statements involves the generalisability of data to a measurement, observation or other description within and beyond the domain from which the data were collected. These include:

- development of concepts: Walsham gives the example of 'informate' from Zuboffs' work, which implies how through the use of computer-based IS certain processes or new activities can become visible, which in earlier paper-based systems were hidden.
- drawing specific implications in particular domains of action: An example given by Walsham of this type of generalisation is an in-depth case study of IS development in a financial services company (Walsham, 1995, p80). In this study the relationship between the design and development process and business strategy is examined. An arbitrary methodological approach to computer-based IS development, with a clear business focus can result in rapid systems development, but can also lead to lack of integration and inflexibility. On the other hand if there is heavy reliance on formalised methods the IS development can be slow and time bound when the business vision and related IS strategy is unclear. The implication, in this study, is a good description of what Walsham terms a 'generative mechanism', which could be used in other organisations and contexts.
- developing 'rich insight': Giving the example of Suchmans' concepts of 'plans' and 'situated action', her various theories regarding human-machine interaction and specific implications, her contribution is described in this broader category of rich-insight (Walsham, 1995, p80). This type of generalisation is used to capture those contributions that cannot be easily described as concepts, theories or social implications.

Empirical to theoretical:

This category of generalisations includes the moving from the empirical base of a case study to a theoretical base by revising, editing, highlighting or generating theory.

- generating theory: This involves the generalisability of measurements, observations, or other descriptions to theory, and the generalisability of the resulting theory beyond the domain that the researcher observes. Walsham gives an example from Orlikowski and Robey's (Orlikowski and Robey, 1991) work in IS to construct a theoretical framework concerned with the organisational consequences of information technology. They suggested that this framework could be used in systems development and the organisational consequences of using IT.

To illustrate how some of the above generalisations can be made, the example is given in the next section of an interpretive case study in South Africa concerning the design and development of a community-based health IS.

CASE STUDY

After 1994, the South African government gave top priority to using the Primary Health Care (PHC) approach in the delivery of health services. The PHC approach emphasises the need to serve the community and recognises the importance of community participation in the delivery of those services. The UThukela District Child Survival Project (TDCSP) was selected by the National Department of Health as one of three learning sites for the development of a community component to child health in 1999, including the design of a community-based child health IS. TDCSP is a non-governmental organisation, which operated initially in the OKhahlamba municipality from 1995 to 1999 and expanded to the rest of the district from 1999 to 2003. Through a partnership with the community and Department of Health, TDCSP's mission, during the eight years of the programme, was to create a well-being context through child health, maternal health and HIV/AIDS interventions. These interventions were to be co-designed and implemented in a holistic, integrated and sustainable manner.

An action research framework was adopted, as our aim was not just to study and describe an existing situation, but to change it through specific interventions. The action research approach was informed by

Elden and Levin's (Elden and Levin, 1991, p130) action research model and incorporated the familiar five phase cyclical process, namely diagnosing, action planning, action taking, evaluating and specifying learning (Susman and Evered, 1978, p588). The cyclical approach to implementing, analysing and evaluating the changes in the IS, involved both the researchers and participants and is illustrated in Figure One.

Given the joint nature of the participatory research approach, a research team was established at the outset. Participants for the research team were selected by the Project and based on the positions they held within the district, the networks they were in, the skills and expertise they possessed, as well as their willingness to participate. For example, the community field facilitators had strong links with local government structures, whereas the community health workers had links with the household and the health facilities. One of the authors of this paper was engaged with the Project since 1997. This engagement involved the facilitation of meetings to develop a common understanding of the role of IS, training on data collection techniques and instrument design, conducting field work, facilitating group data analysis sessions, writing reports and facilitating feedback sessions and training on the use of new tools. The roles and responsibilities of all parties were not only agreed to and documented for clarification purposes, but also to avoid confusion or misunderstanding potentially arising at a later date.

After agreement on the roles and responsibilities of the various parties was reached, the next step taken in this process was the development of a common vision for the role of IS in supporting the attainment of the community's vision for child health. A co-determined vision for child health (*To achieve optimal health, growth, development and well-being of children in the UThukela Health District)* was achieved through community and district meetings and participatory exercises with different groups of people within the community.

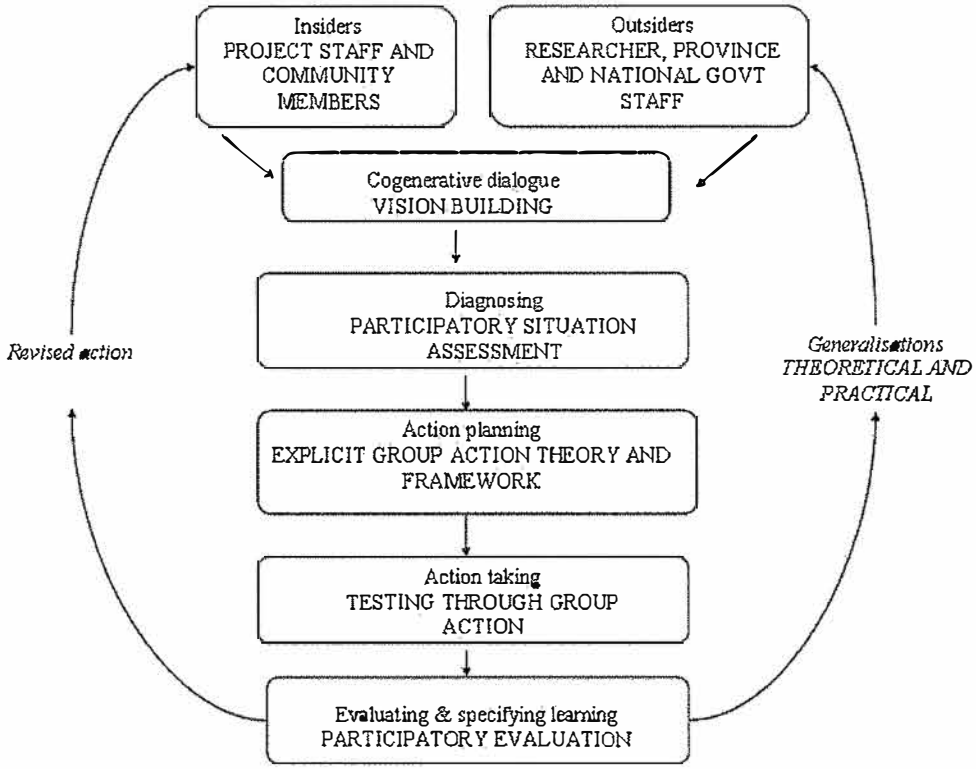

Figure One: Participatory action research model

A participatory situation assessment was then conducted to understand what IS were already in place and how they were designed, along with an assessment of the health-care and health-seeking practices around children and their current status. Resources available (human, financial and institutional) were also mapped. Issues around participation, communication and capacity formed major themes in the assessment. The participatory situation assessment and the reviews and evaluations of the health IS enabled the various role players to understand the existing IS and to review it in terms of their needs (BDCSP, 1999; TDCSP, 2001). Additional surveys and reports from the project (BDCSP, 1996a; BDCSP, 1996b; BDCSP, 1999b; TDCSP, 2000) provided a broader understanding of the area, as well as giving accounts of the local knowledge and practices with respect to child health. From this research the main people responsible for child health and other key people in the community were identified. These included: community health workers, clinic health committees, traditional leaders, councillors, social workers, early childhood practitioners, mothers (including teenagers), fathers, grandmothers and Project staff.

Additional research on developing a child-health community-based IS was then conducted to understand the information needs, who should be involved in the development of the IS and the format in which the information should be communicated. A total of 10 interviews, 15 focus group discussions and 1 meeting took place between July and September 2002 (one additional FGD with children was conducted in May 2003). Different viewpoints expressed by community members facilitated a greater understanding around the meaning of 'well-being' and 'at-risk' for a child, what actors/practices contribute to these situations, how the situations can be measured and, based on what action needs to be taken, who the information should go to and in what format.

The results of this research, along with the situational assessment, led to recommendations for a revision of the health IS to incorporate a child-health community-based IS. After implementation, an evaluation of the system resulted in reflection and recommendations for further changes in the system. The evaluation of the project, which included an evaluation of all the interventions, was conducted in November 2003. Identifiable benefits to date are largely process-oriented: in other words, improving the processes by which the health IS operates rather than the impact the IS had on child health. More broadly, the community-based IS has helped to emphasise the importance of information at community level within a district health IS, making it clearer where information should flow based on who can take action, and highlighting the importance of feedback of information to the community-level partners in child health.

The National Department of Health and UNICEF requested work, on the development of a child health community-based IS, to be carried out in two other provinces based on reports and feedback received from this case study. Though we cannot replicate in total what has happened in one area to other areas as the situations and contexts faced in different districts and provinces vary considerably, we were able to learn and apply lessons from the uThukela experience to these new settings. Given the resources required to conduct such an intensive study in the other provinces, we focused on what generalisations could be made, on a practical and theoretical level, based on the work in the UThukela District. Despite the need for situated approaches, we argue that the need to consider generalisations strategies stems in this case from the similarities in the problem of vulnerability, standardising the complex health care structures, and issues of costs. The particular aspects of that research approach, process and output is now described.

Research approach and process:

The research strategy adopted in developing the community-based child health IS is characterised by three key features: action research, longitudinal design and interpretive. Each of these features is now described in relation to the specifics of the research undertaken.

- Participatory action research:

The creation of partnerships from the outset in terms of defining roles and responsibilities and in determining a co-generated vision within the district was an essential step in the action research approach adopted in this case study. The partnership was with the community, the Department of Health and the Project. The underlying principles of the partnership were genuine community involvement using a

community development approach where health is seen in the context of broader human development. The adoption of small incremental steps and a flexible approach was needed to fit in with a busy community life. For example, field work and participatory discussions were conducted after the crops had been harvested, postponed for important meetings and festivities, and conducted as near to the participants home or place of work.

- Longitudinal:

Since changes are to be made in small incremental steps a longitudinal approach is necessary. The process of specifically developing and designing the community-based IS commenced in 2002 and the implementation of the revised system commenced in the first half of 2003. However the work built on IS development which had taken place since 1995. Fundamental to this longitudinal approach was the desire to operate within existing structures and institutions and to build on activities which were already in place. Furthermore, to really ensure participation there is the need for capacity development at all levels and this cannot take place within a timeframe imposed by outsiders. Time is needed to understand the context and to build a trusting and caring relationship between all members of the partnership. For example, the involvement of the Project and one of the authors with the community over a period of several years meant that trust had been established between all members of the research team and consequently little distinction between who the "insiders" and the "outsiders" was discernible.

- Interpretive:

As the members of the community who were responsible for child health had been identified in the participatory situation assessment representatives from these community groups were involved in the research to investigate the different meanings held by the various parties involved. One of the main tasks was to develop an understanding of what the community meant by 'well-being' as the vision for that district was the attainment of 'well-being' for all children. The indicators developed, and subsequently incorporated into the community-based health IS, were based on the meanings of 'well-being' and 'at-risk' obtained through the interviews and focus group discussions. An understanding of traditional forms of communication, such as song, dance and drama, enabled community members to express their views and participate in the research process in a manner in which they were comfortable. Additionally, these forms of communication were then incorporated into the health IS. For example, data collected is relayed back to the community members at the village health days using familiar dances and songs.

Research outputs:

Based on the results of this research five main changes to the district health IS were made. These included:

- Determining community's own indicators:

In line with these views of holistic health, new indicators were included into the community-based IS. Specifically these indicators include measures for the context in which a child lives, as well as including indicators that extend beyond the physical health of the child. The new indicators included information on communication and relationships within the household, deaths within the family, employment and access to education and social services. Discussions were held subsequently between different members of the community and district staff, so that a common understanding on what the indicators meant could be reached

- Formulating changes in data collection forms:

In order for the new data items to be collected there was the need to revise the data collection forms. However, one of the tools, the community health worker observation tool, is not simply a revision of the old data collection forms, but is used to facilitate dialogue with the household.

- Creating forums for analysis and reflection:

To stimulate reflection and use of the community-based data, different discussion forums were enhanced. For example, the monthly meetings among the community health workers now include individual reflection

as well as group reflection on the data. The village health days were enhanced to include a process of assessment, analysis and action based on the data presented. Data is presented through song, dance, poetry and histograms.

- Implementing changes in the information flows for improved feedback:

One of the outcomes of the review of the existing health IS was that there was useful information being generated by that system, for example, indicators around child growth and immunisation, but the key role players and duty bearers were not receiving this information. Many of the role players felt that if they had access to the right information they would be able to act based on that information. Emphasis was placed on appropriate feedback of appropriate data for different levels. This was particularly important given that different role players had become key to the health system since the original district health IS had been designed, e.g. the introduction of community health workers in the district and the establishment of the local government community-based structures. Households receive feedback immediately from the community health workers during their visits, communities receive feedback on the information at the village health days, and health facility staff receive information from the district information officer.

- Increasing visibility of conflicting territorial/geographical boundaries:

After the data had been collected by the community health workers and submitted to the district office it became evident that the area in which the community health worker was working and collecting data did not correspond to the official catchment areas of the health facilities. This caused problems in the integration of the data sets being collected by the health worker, and how they were supposed to be filled in the official data collection forms. This mismatch became visible only when we were discussing the issue of scaling the system from one municipality to the complete district.

DEVELOPING GENERALISATIONS: RESEARCH PROCESS AND OUTPUT

After analysing these key characteristics of the research process, we now discuss some specific generalisations that can be made from this study, both with respect to the research process and output. In this section two examples of generalisations, from the above case study, are explored. These include one empirical to empirical, and the other empirical to theoretical, generalisation. The empirical to empirical generalisation relates to the manner in which participation was reconceptualised through this study and how this reconceptualisation has more general learnings to other settings. This is an example of the drawing of specific implications. The empirical to theoretical generalisation relates to the development of a communication framework which extends Habermas' criteria for the attainment of the 'Ideal Speech Situation' and can be used in other IS design contexts. This is an example of the generation of theory. These examples are illustrated in the table below and now explored in more detail in the following text.

Category of generalisation	Type of generalisation	Generalisation from case study
Empirical to empirical	Drawing of specific implications	Reconceptualisation of participation
Empirical to theoretical	Generation of theory	Communication framework

Table Two: Generalisations from the UThukela District case study

Reconceptualisation of participation

In this case study, participation was reconceptualised in at least four different ways:

- Involvement of the community is needed:

There are very few examples of the participatory designing of IS outside of the work context in published literature. When related to community development programs the argument for participation is based on a more intuitive and ethical basis rather than on empirical grounds. Furthermore, there is the need to move beyond the idea that the community is homogenous/monolithic and cognisance be taken of the need to include various 'sub-communities' in the development of a community-based IS. Additionally the usual

focus in IS design is on the participation of the end-users and little regard is given for those people who will be affected through the delivery of the services by these end-users. This requires broadening the scope of the term 'users' of the IS to include all those affected by its implementation. In our case this was done through the inclusion of all the role players identified as responsible for children's 'well-being' in the design and development of the community-based IS.

- Adopting a multi-level and multi-sectoral approach:

Conventional participatory design approaches explore IS design mainly in one organisation, though, in some cases, has included the different hierarchical levels within that organisation. Rarely has participatory design been analysed between different organisations or from different sectors of the economy. Indicators for holistic child health covered areas concerned with education, infrastructure, social welfare and employment. It was important not to duplicate existing systems, but to build upon what was already there. Therefore, the identified role players who affect the development of a child in this case study, represented both multi-sectoral (health, education, welfare and local government) and multi-levelled (household, community and district) groups. An IS that would then support these key players, and take their interests and concerns into account, necessitates a multi-levelled and multi-sectoral approach.

- Emphasising the political nature of the participatory process:

In terms of the process recognition of the different social groups and power differentials between groups is not sufficient to address them. In participatory design capacity to participate is usually assumed, but there is the often the need to develop this capacity to participate. An initial position that can be taken is the opening up of spaces for dialogue and the establishment of communication loops between the different levels. Based on the research conducted it was discovered that in this District, the care of a child on a day-to-day basis is primarily the responsibility of the mother of the child, but in terms of traditional beliefs the 'well-being' of the child is, in effect, the responsibility of the family. The father of the child and the paternal grandmother will ultimately be the main influences in the decision on what care-seeking practice is adopted. Thus household visits by the community health worker included discussions with all the main decision-makers and thus information flows extended to all family members.

- Integrating participation with action research:

Participation is enhanced through the adoption of a participatory action research approach. The methodological approach adopted emphasises the need to incorporate small incremental steps in a flexible manner and as members of a team or partnership. These steps include: developing partnerships; creating a vision; participatory diagnosing of the problem; action planning; implementation, and participatory evaluation. Essential in this process is the need to create networks at local levels, for example between the various district level government officers, as well as more broadly, for example provincial and national health structures. Integrating participatory processes within an action research framework potentially can create more effective possibilities to address real life problems through the linking of theory and practice (Habermas, 1973). By involving community members in the diagnosing phase of the action research the gap in the health IS of community-based data was identified. Agreement on the need to develop a community-based IS and getting participation of community members to conduct further research was a natural progression from the situation assessment findings and the community's recommendations on the need to address this gap.

Participatory design has been a topic of keen debate in the IS literature, though largely confined to Western contexts. However, some evidence of the attempts to extend IS research to 'developing country' domains has recently become discernible in the mainstream IS literature (for example, Braa et. al., 2004a and Puri et. al., 2004). The way in which participation is incorporated into the IS design and development process and output will be contextual. This argument is supported by an analysis of three case studies implementing health IS in developing countries, including the case study presented in this research. In this analysis, though common strategies, such as capacity development, could be found that cut across the three case studies it is the importance of the contextual nature of participatory design that emerges most strongly. There is no single algorithmic best practice regarding participatory design in IS which is applicable to all situations (Puri et. al., 2004). Hence, the four ways in which participation has been reconceptualised above will vary in their applicability and emphasis in a given context.

Communication framework

An empirical to theoretical generalisation developed from this case study is the articulation of a theoretical framework for communication. The empirical work in the case study focussed significantly on the development of enabling conditions within which different relevant members could express their views and participate in the development of the community-based health IS. This process of creating these conditions corresponds to the theoretical notion of 'Ideal Speech Situation' articulated by Habermas.

The 'Ideal Speech Situation', as the name implies, is ideal and Habermas does not claim that all communication boundaries can be surmounted in attaining this state. So clearly the 'Ideal Speech Situation' was not achieved in this case study. However, striving for the attainment of the 'Ideal Speech Situation' helped the research team and participants to:

- highlight and sensitise issues of power;
- build on existing structures and systems;
- develop capacity and the accessibility of participation, and;
- understand the important role of communication and sharing our meanings in IS design and development.

The principles for attaining the 'Ideal Speech Situation' provide a useful framework in which cognisance was taken of the criteria needed in developing forums for communication, but also assisted in the analysis of the process followed. The criteria include the extent of access; the degree of autonomy; the rejection of hierarchy; the rule of law, and; the quality of participation.

Our empirical work provided insights to extend Habermas' ideas in two ways. One was the application of the criteria to a specific context in South Africa. Furthermore, the 'Ideal Speech Situation' is extended to specifically examine the "distortions" which occur in achieving the 'Ideal Speech Situation'. For example, our empirical work identified various distortions in terms of limitations faced when we had combined meetings with representatives of the community, project and district staff, on the determination of indicators. The people associated with the community were reluctant to offer suggestions on how the proposed data could be collected and how best to define the indicators within this meeting. The combination of the different hierarchies in the group impeded full participation from all participants. Another potential distortion identiified is the difficulty faced for many women to participate due to 'time-poverty'- that is, given the excessively long days that women work finding the time to participate in the forums established may not have been possible.

This notion of incorporating distortions within the 'Ideal Speech Situation' concept leads to a communication framework which can be usefully generalised in other settings. For example, in the Western world, distortions may arise from the time constraints members have to participate, while in other developing countries settings inadequate knowledge or poor infrastructure could potentially lead to distortions. The communication framework developed through this case study is summarised in Table Three.

Criteria	What was achieved	Potential distortions
Access: (close to universal)	• Local language used. • Close to home or work. • Known facilitator or mediator. • Participatory techniques employed. • Flexible approach.	• 'Time-poverty' of women. • Used existing structures with existing constraints.
Autonomy: (free of coercion, allowed to question, and can introduce any assertion)	• Not obligatory to participate.	• Social pressures and tradition. • Could say what they feel facilitator wants.
Hierarchy (ability to participate, and	• Good participation in smaller groups.	• Poor participation in mixed groups.

free to express attitudes, desires and needs)	• Use of participatory techniques.	• Influence of social inequalities and hierarchical structures.
Rule of law (especially lower levels of government)	• Participation endorsed in legislation. • Traditional communal decision-making.	• History of non-participatory government. • Insufficient knowledge of, or capabilities to demand for, rights.
Quality (common commitment to the ways of logic, and the competence to speak)	• Long history of TDCSP. • Capacity of facilitators and community members developed.	• Less participation in larger groups.

Table Three: Characteristics, achievements and potential distortions in striving for the 'ideal speech situation'

CONCLUSION: SOME IMPLICATIONS FOR HUMAN RESOURCES DEVELOPMENT

While a major focus of the study has been on enabling activities that could support the development of capacity of various people to participate in the design, development and implementation of the community-based health IS, the focus in this section is on the development of the capacity of researchers to conduct similar studies, in other settings. A challenge for generalisation is how can the learnings gained from this study be translated and adapted by researchers conducting similar analysis in other settings.

Conducting a study like the one carried out in the UThukela District is a very resource intensive process, requiring significant investments of time. The researcher needs to be competent in various areas to carry out such research, for example on developing research designs, conducting focus group sessions, facilitating communication, understand local level politics, negotiating with the health authorities etc. Such competencies are not just academic in nature, but also require more broader skills of communication, negotiations, and public relations. As such, there can be no set recipes or methodologies on how such competencies can be developed. However, there can be orientation sessions organized for the researchers to develop awareness of the kind of competencies that are required, and what was the experience of researchers in other settings. The documentation and the development of generalisations from interpretive case studies can support this orientation process. Such awareness building, it is argued, can enable processes of critical reflection and lead to improved competencies of researchers to conduct similar studies in other settings.

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SESSION A3: RESEARCH PAPERS: THEORETICAL PERSPECTIVES

Challenges of User Participation in the Design of a Computer Based System: The Possibility of Participatory Customisation in Low Income Countries

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ABSTRACT

Participatory design is generally regarded as an effective approach in systems development to overcome challenges such as changing contexts, difficulties of capturing users' needs and problems of achieving systems' acceptance. However, user participation is associated with certain contextual assumptions or beliefs from its origin in the West that are not always applicable in the context of Low Income Countries (LICs). The initial technical capability of users, motivation and desire to participate, availability of resources and long-term support mechanisms are often taken for granted in the West, but in many cases not present in the context of LICs. In the Western setting, due to favourable socio-economic and political conditions and the presence of skilled users, an approach to design of systems from scratch with user participation tend to give quality systems. However, in a LIC setting where the intended users have limited computer skills, there is a need to put an extra effort into training and to find alternative approaches to achieve participation in system design. In such a setting, we argue that participatory customisation, a process where the users in collaboration with the developers adapt an already developed or partly developed system to meet the needs of their own workplace, can be a better approach. In this paper we approach participatory customisation in LICs by looking in detail at the customisation of the District Health Information Software (DHIS) in two pilot health districts in Tanzania. The Tanzanian project is part of a global research initiative (the HISP), and in order to put forward more general approaches for LICs, we compare our findings from Tanzania with similar customisation processes in Cuba, India, Mozambique and South Africa.

Keywords: participatory design, participatory customisation, HISP, LICs, Tanzania.

INTRODUCTION

In a western setting, participatory design (PD) has proved to be a relatively successful approach to system development; however a successful user participation process requires certain contextual properties, such as skilled users (Kyng, 1994, Emspak 1993) and a cultural and political setting that is supportive of user participation, also at the local level (Heeks 1999a). The lack of computer skills in Low Income Countries (LICs) is widely acknowledged (Walsham *et al.,* 1988; Sahay 2001). LICs face lack of infrastructures and lack of quality ICT education. These constraints to participation demand a strong focus on training of intended users in computer basics in order to let these users contribute to the participatory process. Furthermore, when collaborating with users that do not possess the skills a developer would normally expect in a western setting, there is a challenge to find alternative ways of approaching user participation that do not demand the same technical understanding.

During the last 7-8 years, important elements of the Scandinavian collective systems approach has resurfaced as a strong political "design movement" in South Africa through the Health Information Systems Program (HISP) (Braa 1996, Braa and Hedberg 2002). Born out of the anti-apartheid movement and combined with Scandinavian systems design influence, a participatory systems design project established in three pilot districts gradually spread out to cover the entire country and is today the official health information system in South Africa. HISP's relative success in South Africa has led to the export of software and ideas on health management to countries like Mozambique, India, Malawi, Mongolia, Cuba, Tanzania, Ethiopia and Vietnam. The HISP focuses on action research and user participation, especially local participation to customize the health information software with the aim to develop local knowledge and skills in computers, design, data handling and use (Braa *et al.* 2004, Williamson *et al.,* 2001).

Ever since it was developed in 1997, the District Health Information Software (DHIS), as the software tool is called, has gone through many improvements that are applicable to all countries, but it has also been customised in every country to meet the needs of the local contexts (Braa *et al.* 2004).

The last two years the Tanzanian Ministry of Health (MoH) has implemented the DHIS in two pilot districts. A HISP-team of foreign and national researchers has run the process of customising the DHIS to the Tanzanian context. The adoption of HISP approaches to systems development led to a strong focus on user participation and local-level involvement in this customisation process. One of the authors was part of this HISP-team and involved in implementation, customisation and training of the DHIS during several field studies. This paper presents a case study from this project, and to take advantage of the research in the global HISP network, we compare the Tanzanian case findings with other similar projects in Cuba (where the other author was engaged in a HISP project), South Africa, Mozambique and India.

In this paper we approach the following questions: What are the challenges of applying a participatory approach in LICs, and how can we address these challenges in a context so different from the Western conditions? The rest of the paper is organized as follows; section 2 gives a theoretical background to participation and customisation, section 3 outlines the research approach, and section 4 presents the Tanzanian case study. Section 5 covers the discussion, and finally in section 6 we summarize and outline some concluding remarks.

THEORETICAL PERSPECTIVES: PARTIPATORY DESIGN AND CUSTOMISATION

Participatory design

Participatory design grew out of Scandinavian trade union initiatives towards democratisation in the workplace over the last three decades (Ehn, 1993; Bjerknes and Bratteteig, 1986) and since then it has received a growing attention in the Western setting (Gould and Lewis, 1985; Grudin, 1991a & b; Kyng, 1991; Schuler and Namioka, 1993). Skilled users and developers mutually collaborate to create quality computer systems while enabling learning and reducing communication problems. However, several favourable cultural, socio-economical and political conditions in this setting help to promote a joint technical development endeavour (Ehn, 1993; Bjørn-Andersen and Hedberg, 1977).

Participation of skilled users is intended to mediate work practices and to enable smoother changes to system use in the context (Kyng, 1994). Intended users play a significant role in decisions about organisational aspects rather than technical (Cadle and Yeates, 2001; Walsham et al, 1988) whereby the lack of effective communication with intended users often lead to insufficient capturing of design needs and thus system failures (Curtis et al. 1998). Intended users and developers need to agree on what is being designed by sharing technological and contextual understandings and available design options (Kraut and Streeter, 1995). Thus, knowledge gaps (such as perception about technology, language, terminologies, jargons, etc) are resolved in joint collaboration (Oliver and Langford, 1987; Davis, 1982) building common understandings, motivation and effective participation (Kyng, 1994; Damodaran, 1996). However, effective participation is a result of motivation, skills and knowledge of both intended users and developers in a suitable environment where intended users can feel fully empowered. Typically, users with lack of skills are ineffective in participation and have less influence in the design. As Emspak (1993) puts it:

> *If one is ignorant of what alternatives are possible then it will be impossible to win them. The central point of making ideas into reality is knowledge (p. 20).*

For intended users to contribute to the design they must possess skills so that the focus of the design process can emphasize the users' abilities and needs rather than solely on quality and efficiency of the system (Grønbæk et al., 1993). User participation needs to go beyond participation of skilled users in design, and also incorporate training and learning (Bødker et al., 1987, Tollmer, 2001) to empower intended users with lack of skills to contribute in the design in the long run (Walsham, 2002). Moreover, training of intended users prior to their participation creates a democratic and empowered environment (Byrne and Sahay, 2003).

A system has different user groups with separate skill-requirements and interests. These differences can be addressed by creating user-group representatives that participate in training and design, or by working with

larger groups of participants with similar interests and requirements (Avgerou and Cornford 1993). Selecting skilled users is a crucial step (Bødker and Grønbæk, 1991; Heeks et al. 1999b) in a participatory process, but in the context of LICs such users are not necessarily available. Heeks (1999a) explores the effect of participation in LICs, and he points to several factors limiting the value of participation. One such example is cases where participation is not really participation, where the culture and politics in an organisation prevent participative outcome from apparently participative processes, by constraining who can say what and how within different groups (Biggs and Smith 1998).

Customisation

Customisation, adaptation and tailoring are terms often used interchangeably to describe changes to systems design by users. According to Gasser (1986) adaptation implies any of the following three scenarios; 1) changing work practices to accommodate for design misfit, 2) undertaking additional work to make up for design misfit, or 3) using the original design in ways it was not intended for. Tailoring can be understood as a process where the users or even organisations adapt the design to handle new circumstances that originally was not anticipated (Cook and Woods, 1996; Randell, 2003, Watson, et al, 2004; Stiemerling et al. 1997).

Customisation means that the intended users change the system design in order to reflect their work practices and needs (Randell, 2003; Page et al. 1996). The design of an already existing system is customised with user participation where intended users, not necessarily with high technological skills (Mackay, 1991), are initially trained to be able to participate. Thus, participatory customisation implies that the developers initially work closely with the intended users, thereby enabling them to gain better practical control of the design, and an understanding of how their work practices and needs can be reflected in the system. By initially being guided in design changes in collaboration with the developers in a learning-by-doing process, the users themselves are later able to make design changes. In contrast to a more traditional participatory approach, this interpretation of customisation helps intended users to influence design decisions by designing parts of the system themselves. This process may enable a design culture that empowers the users to tailor the system (MacLean et al. 1990) and make changes to the design when needed, even after the developers have left the scene.

RESEARCH SETTING AND APPROACH

This study is based in the LIC Tanzania, located in Eastern Africa. The country's literacy rate is 67.8% and the national language is Swahili, a language spoken by 90% of a population of 34.5 million. Swahili is the compulsory teaching language in primary schools, and a large part of the literate can only read and write in Swahili. English is used in the secondary and tertiary educational levels. The quality of education is affected by a low morale among the teachers, poor conditions for learning, and lack of educational resources (Juntunen, 2001).

Tanzania started the process of redesigning the Health Information System (HIS) in the early 1990s, through engagement in the development of an integrated, both paper-based and computerised HIS, with the assistance of multiple donor agencies (Rubona, 2001). However, due to the shortage of skilled manpower and resources, and dependence on external support, such efforts have not produced positive results. The health system is still centralised, making it difficult to implement the Primary Health Care (PHC) strategy (WHO 1978). The health system's organisational structure consists of four levels; health facility, district, regional and national, whereby the district level represents the hub for all information flows. At the regional and national level the HIS is computerised, but the software in use has been reported to have a number of pitfalls, such as lack of design flexibility and missing functionality (Lungo, 2003). At the district level there is a lack of software to support data processing and to make use of the information. Thus, implementing and customising the DHIS in this context was an important goal in the Tanzanian HISP project. The HISP-approach was introduced in two pilot districts, Bagamoyo and Kibaha health districts, both located in rural areas not far from the city of Dar es Salaam.

Action research as an approach

This study is part of an action research initiative within the global HISP project (Braa et al., 2004). In general, HISP aims at strengthening design, development and implementation of sustainable HISs in LICs

with a focus on building local capacity of health workers to effectively design their own systems, operate computers and use information for action. HISP applies action research to meet these targets in such a way that health workers and HISP researchers can work together, share knowledge and experiences and thereby become more aware of the options and possibilities for change in the local context, and then collaborate to make change. The key action research strategies are training and participatory customisation of the DHIS to facilitate learning. One of the authors was involved in the implementation, customisation, and training of the DHIS in two districts (Bagamoyo and Kibaha) for the period of two months, from June to August 2003. The research study was further extended for a period of 3 months from January to March 2004 to include user support and situation analysis in the pilot sites.

In each district the training participants were district information officers, vertical programme coordinators and data compilers. The training and customisation of the DHIS was conducted through first an intensive period of one week (4 hours in the morning and 4 hours in the afternoon), and then a follow-up period of 2 months. The mode of training was based on presentations of the DHIS user-interfaces and functionality followed by discussions with trainees on the particular features. The last training session was an evaluating the trainees' competence in computer use and the DHIS. Group discussions with the trainees during break times, separate unplanned interviews, planned meetings with health managers/health officials and participant observation provided more understanding of the existing work practices, health workers' capabilities and motivations, their interpretation of computers, and their roles and barriers in the design process.

THE CASE STUDY

The DHIS software

The District Health Information System Software (DHIS) is a free and open source database application for collecting, processing, and analysing health information for health administration purposes.

The software is developed in South Africa using the technologies MS Office (Access) and Visual Basic, and it is the basis for the customisation process in Tanzania as well as in the other countries in the HISP network. The key advantages of the software as a customisation tool are its flexibility; it can be quickly changed and adapted to typical routine health information systems' needs, and its support for multiple languages; the user interfaces can be translated to any Unicode supported language and alphabet. The rationale for designing such a flexible system was to support decentralisation of health management and to empower the lower levels (especially the districts) of the health system, by giving them the possibility to customise an information system to fit their needs, as opposed to the more traditional centralised systems. This flexible application, though originally intended for the South African Health System only, has proved suitable for customisation in other countries and health systems as well.

When introducing the DHIS in a new context, in this case the Tanzanian Health System, the implementation can be seen as a continuous customisation process where most of the work is done out in the field with participation from the domain experts. The system is gradually being tailored to the local context and the developers' involvement changes from strong at start-up to almost non-existent when the users are trained and comfortable with the software.

Customisation of the DHIS in the Tanzanian context

The first step in customizing the DHIS (step 1 in Table 2 below) in the two pilot sites was to define the overall database structure, meaning how the organizational hierarchy, the health facilities, and the data collected by these facilities are represented in the computerised system. This process was done in collaboration between the developers, who knew the technical part well, and the domain experts, who had knowledge about the local structures and data flows.

Step	Task	Actors
1	Set up the overall structure of the database: Organisational hierarchy and the data sets to collect.	Developers and local health management.
2 (a)	Customise system use to local context.	Developers and health workers.
2 (b)	Customise system use to local context.	Health workers only.

Table 2 Steps in customisation the DHIS

This first database prototype was then set up on each individual computer, and training in application use was organized. In parallel with the training, further customisation was conducted (as shown in step 2(a) of Table 2). Among the many features provided to the local users in order to customize the DHIS are: add or modify data elements to be collected (such as number of deliveries, number of inpatients etc.), define local indicators, design local validation rules, modify graphical user interface features (such as labels, text boxes, logos and images), edit the language, switch from one language to another (e.g. English to Swahili), and to define reports based on the needs of the local facility.

Given the lack of computer skills among the health workers, the first task was to train them in computer basics. The HISP developers emphasized hands-on training where each health worker had its own computer, as a strategy to build up their confidence in computer use, and thereby eliminating their computer-phobia and increasing their effectiveness in the customisation process. It was assumed that by providing the health workers with basic computer skills, the developers could help to empower them with the necessary design skills (e.g. sketching using mouse, using menus etc.) for the customisation process. The user empowerment and participatory customisation processes were conducted in three stages as shown in Figure 1 and Table 3.

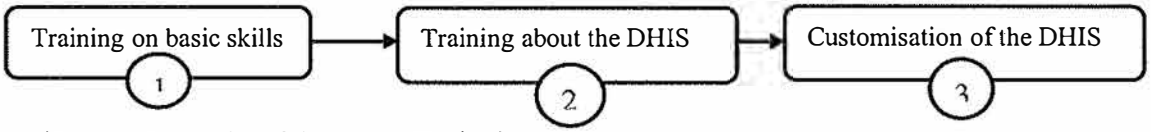

Figure 1. Stages of participatory customisation

Stage 1: Health workers learn computer basics, assisted by developers. • Computer hardware basics. E.g. keyboard, mouse, monitor, memory, hard disk, floppy disk, printer, etc. • Operating System basics. E.g. using windows, menus, command buttons, mouse movement and clicks, etc. • Microsoft Word. E.g. how to write a document, save, open, print etc. • Microsoft Excel. E.g. simple manipulation operations and graphical representation of data • Microsoft Access. E.g. how to define a field and set its properties, create tables and how to create a simple database.
Stage 2: Health workers learn to use the DHIS on their own computer, assisted by a developer • How to install the DHIS on their own computer. • How to browse through the DHIS features e.g. command buttons and text boxes, and how to edit them. • How to customize the DHIS, the organization hierarchy definition, local changes to the structure, unit-specific data elements (beds, human resources, etc), data element categories, routine health data elements (BCG, malaria-cases etc), semi-permanent data (population, targets etc.), indicators, and report generation. • How to input, edit, and validate routine data and semi-permanent data and how to calculate

indicators.
Stage 3: Do it yourself- health workers and developers now work together • Redefine DHIS user interface's features showing possible suggestions such as images, text labels, etc. • Re-define local health data items and indicators. • Enter quarterly routine data and generate reports using the DHIS. • Define and make reports through the DHIS. • Export data to the Excel environment and analyse data using pivot tables and graphs. • Suggest features to the developers that can improve the DHIS.

Table 3. Description of the stages shown in Figure 2

Evaluation of the customisation process

The evaluation conducted after the training and customisation process demonstrated that:

- Health workers obtained some hands-on experience in computer use and design through customisation based on the local DHIS developed in collaboration between health workers and the HISP team.
- Health workers could for their first time design graphs in Microsoft Excel presenting their health data in a more illustrative way.
- Health workers obtained some confidence in using computers and the DHIS, e.g. they managed to enter most of the reported health data from 2002 and 2003.
- Health workers realised the potential benefits of their participation in design as they gained more knowledge about the DHIS and computer use in general. Some health workers managed to learn how to develop different graphical representations from the data, e.g. a graph on the immunization status of the district which was very fascinating to the person in charge of the district immunisation programme.
- Health workers' computer-phobia was to some extent eliminated as they learned how to use computers and how the computers work.
- Health workers were able to participate in the design process by e.g. suggesting improvements on how to better represent the paper forms in the computerized system.

Challenges and limitations of participatory customisation

Although the previous section has presented some positive results of customisation, there were several challenges that limited the outcome of the user participatory process.

Lack of motivation

The lack of motivation by users was evident in the poor attendance during training sessions, excuses from managers pertaining attendance to the training, and practical utilization of skills acquired after the training. Moreover, we experienced a tendency of having users who had attended the training for financial gain only. An example from one of the pilot districts illustrates this. Early in the training process we organized two different sessions, one in the morning for normal end-users, and another in the afternoon for higher level users (doctors and managers). However, the afternoon session's participants did not show up for training and thus we extended the morning session. Asked about the absence of doctors and managers, the morning session's participants replied, "Some of our colleagues thought there were training incentives; that is why they dropped out". The health managers, the most important user group both considering design and use of the DHIS, were said to be too busy in dealing with direct health services, to have time to participate in the pilot project. Moreover, some users perceived participation as a way of getting more financial income, but HISP did not have the resources to motivate the participants by reimbursing them for their time spent in training.

Difficulties of selecting the right participants

In some cases, the most suitable DHIS participants were not prioritised by the managers, and in stead more personal motives affected the selection process. One example is when a health manager chose his messenger (delivery boy) to attend the training session dedicated for future trainers that were going to the district level to teach health workers. This was clearly not a suitable person for this task, and when the manager was asked about this he replied that the messenger was his close friend, and therefore it was necessary to send him to that training session in order to get something (money).

Lack of basic computer skills

The fact that some of the intended users had never touched a computer before meant that we had to provide close and long-term training to give them hands-on experiences with computers, in order to prepare them for the customisation of the DHIS. Users that were not skilled enough, lacking the fundamental understanding prior to the participatory design process, provided a limited contribution to the design. Furthermore, valuable training resources that could have been spent on improving system design had to be allocated to teach computer basics.

Political brokering at the national level

The initial implementation funding for the HISP project in Tanzania was provided by the Norwegian Government through University of Oslo's (Department of Informatics) research funds. Given the lack of an appropriate computerised system to support district health information combined with the relative success of the South African HISP project, the MoH took the decision to go for a customisation of the DHIS in two pilot districts. However, while at the same time demanding tangible results from these pilot districts in order to scale up, the MoH allocated no resources to help the implementation process.

The HISP-team started to work on to fronts; 1) at the local level where they customised the DHIS in the two selected districts focusing on local level user needs, and 2) at the national level, where they were engaged in a continuous political brokering process to get participation from national HIS personnel and management. Both processes were of course highly dependent on the other.

A typical excuse from national level personnel for not participating in training and customisation of the system, was lack of time due to their many other responsibilities and initiatives at an understaffed national unit. Although some national level personnel were part of the national HISP-team, their participation was only partial and unpredictable. The other HISP-team members were committed to seek participation from national personnel in most decisions about the project, but these efforts did not succeed. The replacement of the national head of HISs in the middle this brokering process made it even more complicated to get national-level support and participation.

As a result of a lack of national-level participation, district management showed some reluctance in using the information output of the pilot system (DHIS) in their daily work, as they were waiting for a sanction from the top level to formalise the project. However, at the national level they were waiting for tangible results from the districts in order to move forward; a typical deadlock situation.

DISCUSSION

User participation in a LIC context

In general, participatory design is regarded as an effective approach in systems development processes to overcome challenges such as changing contexts, difficulties of capturing users' needs and problems of achieving system acceptance. However, user participation is associated with certain contextual assumptions or beliefs from its origin in the West that are not always applicable in the context of LICs. The initial technical capability of users, motivation and desire to participate, availability of resources, and long-term support mechanisms tend to be taken for granted in the West, but are often not present in the context of LICs. Furthermore, participatory approaches, and especially the Scandinavian projects, are influenced and driven by socio-political targets such as work place democracy and local empowerment, and they are often backed by strong and well organized trade unions (Bjerknes and Bratteteig 1995). Such a democratic context for a participatory approach was not present in the setting of the Tanzanian health system, and is hard to find in many LICs.

To understand some of the differences of participatory contexts in the west and in LICs, it can be useful to look at how technology plays a role in these two broader settings, and especially on the way citizens get exposed to technology in their everyday life. The exposure to and experience with technology in the West is generally higher than in LICs. In the West, even if one does not have a computer at home or in the office, one would e.g. most likely have an electronic credit card and frequently interact with Automatic Teller Machines (ATMs) when withdrawing cash, or with terminals in the supermarket when buying food or goods. The mobile phones, or small multimedia computers as they are becoming these days, are another good example. One almost needs to have mobile access to communicate with friends, family or work colleagues, or to call the police or an ambulance. Furthermore, most organisations and businesses in the developed world have one or more computerised systems to support their work processes, such as a human resource database. When deciding to try out alternative software packages or to computerise other sections of their work, organizations would in most cases have a fair understanding of computerised systems.

In a LIC like Tanzania, technology is not exposed to the society in the same way. In some places a computer is looked at as something special ('it is like a superman'). When institutions get a computer through a donation or buy one themselves, the computers are highly protected and restricted to only limited use. In this setting we realized that it is hard for the lower-skilled users to understand the relationship between system design and a running application on the computer, and even more difficult to understand; how can they participate in this mysterious design process?

Given such a context, in order to go into collaborative processes with the users, the developer should find more context-sensitive approaches that do not demand the same kind of basic technological understanding that the developer would take for granted in a Western context.

Participatory customisation -a gateway to understand system design

Participatory design approaches in the West are dominated by design-from-scratch processes involving users from the very beginning of the development cycle. And given the rich human resource capacity and other favourable social and economic conditions in the West (Ehn, 1993), these approaches seem to function well. As we have argued above, these approaches meet difficulties in contexts where the users lack a basic technological understanding. Based on the experiences from the Tanzanian HISP project, we propose that a more effective way to achieve user participation in LICs is to present the users with a pre-developed and flexible system that can easily be customized in collaboration with the developers. Participatory customisation is a better term as we emphasise the importance of a collaborative process between users and developers to customize the system to the local context. Introducing the users to a running application that they can see and interact with, as in the Tanzanian HISP case, facilitated an easier communication with the users in the process of designing a localized system. A customisable system should have the ability to implement visible changes relatively easily and on the fly, so that the users understand that they are participating in the customisation process.

The participatory customisation process can also be understood as a learning-by-doing process where the users learn about basic computer use and application-specific features, while at the same time customizing the system. In the Tanzanian case, customisation and training were often done in parallel, at the workplace, in collaborative sessions with both users and developers.

The importance of learning

Training has been an important part of the DHIS customisation process. Given that most users had no previous experience with computers, training in basic computer use was a necessary first step in order for the users to learn about the DHIS and the customisable potential of the application. Before reaching the participatory customisation phase, a certain amount of basic skills had to be in place (Ehn, 1993), and we experienced that this training helped the users to get rid of initial 'barriers' to participate and empowered them to influence the design of the localised version of the system (Byrne and Sahay 2003). We also experienced that participation increased as the users got a better understanding of the DHIS. An example is how some users developed a hospital information module after first familiarising themselves with the basic features of the DHIS, and being participants in the customisation of a routine health information module.

A challenge during the training and customisation process was to be able to interact with the right users. To develop sustainable systems, it is important to focus on providing training to the intended users of the

system in a long term perspective, and not spend resources on non-users who are not involved in the actual use or maintenance of the system. From the Tanzanian case we have seen that participants in training sessions have been selected for the wrong reasons, e.g. related to internal power-relations, and not for the best of the organisation.

SUMMARY – TANZANIA IN A WIDER CONTEXT

To strengthen our discussions we will look at the Tanzanian case in a wider context comparing our experiences and findings with other similar case studies in the global HISP network (Braa et al. 2004).

How power and politics influence participation

We have seen how local managers in the Tanzanian health system to some degree hampered the participatory process by letting personal interests influence the selection of participants. Furthermore, the lack of full national support led to reluctance to commitment by the local managers and thus less tangible results to convince the national level to scale up.

Conditions for participation differ across the other HISP countries; in India top political support was needed and obtained through political negotiation in an open society. In Cuba, top level support was to some extent present, but only through the statistical line management, which in turn made it difficult to meet the right users in a fragmented health system (Braa, Titlestad and Sæbø, 2004). However, in Cuba support from the political structure is needed in order to carry out local level participation, and a problem in Cuba is that such support is not easily negotiated openly (ibid.). In South Africa the participation at all levels was made possible by aligning a range of actors around common goals of improving health care in deprived communities, and in many ways it was a continuation of the anti-apartheid movement. The political activity (and freedom) and engagement in South Africa have provided good conditions for a participatory approach (Braa and Hedberg 2002). In Mozambique the conditions for participation are good, people are willing and they are definitely allowed to. Problems are rather related to the implementation of design decisions coming out of the participation (Braa et al. 2004).

Local capacity-building

In Tanzania, it was difficult to establish institutional support due to the existing bureaucracy and unwillingness to allocate human resources. National level personnel did not participate whereby they tended to be busy and reluctant, and as a result they became unaware of the capability of the customised DHIS. The development of "long-term" national teams involving participants from multiple levels of the MoH has been important in South Africa, Mozambique and India (Braa et al. 2004). Also in Cuba there were attempts to create such a national team with the overall responsibility for the project. However, this was not successful as there were not enough resources allocated and it was not prioritised by the health authorities, i.e. lack of political support. In Cuba there are several small nodes of skilled groups, but due to lack of a national nucleus they are not communicating (Sæbø and Titlestad, 2003).

The customisation processes

In the process of localizing the DHIS in Cuba the software supported a collaborative process where the users, also with a limited technical background, could quickly come up with suggestions on how to tailor the application. The fact that we had a core application ready, kick-started the participatory process in a normally difficult start-up phase. The way we could implement new ideas and suggestions "on the fly" and show results right away, helped to keep the users active and motivated to participate. The build-in functionality to easily translate the user interface to any desired language was of major importance in Cuba, where we needed a Spanish translation. In stead of spending a lot of time reprogramming the code to translate the application, this was taken care of by a separate multi-language module, and could be done by the local health statisticians without any need for special technical skills (Braa, Titlestad and Sæbø, 2004). When translating a user interface dominated by medical terminology, it is a huge advantage that medical domain experts and *not* the developers themselves are able to do the translation process.

In South Africa where the software has been used for eight years, we have experienced a flow of suggestions on how the application can be used for other purposes than it was initially designed for. The target domain of the software is now much broader, and though some of the new functionality has

requested real programming efforts by the developers, many of the new areas of use have emerged from the flexibility of the software and the ability to customize it to new user needs, and hence did not demand additional programming. Thus, by learning from hands-on experiences with the application, some users have become local experts and extremely important participants in the continuous process of customizing and improving the use of the software.

Concluding remarks

In conclusion we can say that system development in the context of LICs is highly influenced by social, economic, and political factors. The context of multileveled organisations like a national health system represents power imbalances and many different users groups with varying technological skills. Developers often need to build local technological capacity among the intended users prior to involving them in participatory actions. Training in computer use and design enables the intended users to be more than passive participants and empowers them to contribute to the design process. Moreover, the developer needs to tackle issues of power relations and imbalances and seek for allocation of resources to strengthen learning and design processes. Achieving active participation and commitment of top-level personnel have proven important in both motivating and enabling local-level users and decision-makers to participate in systems design. In order for the intended users to better learn and participate in the design, we argue that they need something they can see and interact with, a customisable system where design changes are easily visible to non-technical users. Through participatory customisation the intended users learn by practising and doing, gradually building up use and design skills and thus increasing their ability to customise the system themselves. In the long run, the users are better prepared to handle system changes and improvements without involving the developers, and thereby establishing a culture of design and technology use at the workplace, in their own context.

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Reflecting On National Spatial Data Infrastructure Implementation in India: The Need for Socio-Technical Approaches

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ABSTRACT
Spatial Data Infrastructure (SDI) is a special case of an information infrastructure, aimed at providing wider and affordable availability of application specific spatial data and information through electronic clearinghouse mechanisms. Evidence of the primarily technical focus and the top-down methodologies that drove spatial applications of Geographic Information Systems in the 1980s and 1990s are also reflected in SDI design and implementation. In developing countries like India, the predominantly techno-centric thinking around SDIs continues to significantly impede the progress of the implementation efforts. In this paper, we examine the trajectory of the National Spatial Data Infrastructure (NSDI) development in India in light of different contextual conditions existing in the country vis-à-vis the West. This analysis is based on specific themes around SDIs emphasized in the current literature (viz. the need to inculcate bottom-up design and implementation approaches) that are germane to the Indian context. The analysis points to the need to re-orient the NSDI efforts for realizing its theorized potential, towards which we make a few pragmatic suggestions.

Keywords: SDI, NSDI, socio-technical approaches, top-down, bottom-up design, India.

INTRODUCTION

The relevance and efficacy of applying the techniques of spatial modeling and Geographic Information Systems (GIS) in diverse application areas (such as natural resources management, urban planning, etc.) has been increasingly articulated in the geo-literature during recent years (Dangermond, 1989; Longley et al., 1999; Tulloch, 2002). It has been argued that the inscribed functionality of GIS to manipulate and process geo-referenced data together with the corresponding attribute (non-spatial) data provides a powerful decision-support environment to planners and managers concerned with finding optimal solutions to complex problems in various application domains in which the use of spatial data is a key element (Goodchild, 1992). A major constraining factor in promoting the more widespread use of GIS concerns the institutional constraints associated with acquiring application-specific spatial data, which is more capital-intensive than, for example, the non-spatial data used in more traditional information systems (IS) (Groot, 1993). While this impediment is expected to be, by and large, overcome by adopting the Spatial Data Infrastructures (SDIs) approach within country settings, practically it is found that these institutional complexities are magnified (Koontz, 2003).

Groot and McLaughlin (2000, p. 3) define geospatial infrastructure as encompassing "the networked geospatial databases and data handling facilities, the complex of institutional, organizational, technological, human, and economic resources which interact with one another and underpin the design, implementation and maintenance of mechanisms facilitating the sharing, access to and responsible use of geospatial data at an affordable cost for a specific application domain or enterprise." The thinking towards evolving SDIs initially arose in Western countries, and was driven mainly by the economic rationale of sharing capital-intensive spatial data across enterprise-wide applications (Groot, 1993; Rajabifard et al., 2003). More recently, the need to create a common, shareable repository of spatial and the corresponding non-spatial data, has been articulated to address developmental concerns, viz. environmental, community health issues, land degradation, etc. (Craglia & Johnston, 2004), and also support e-governance (Remkes, 2000) and information society agendas (Craglia et al., 2003). The rationale behind the social "face" of SDIs is that easier and less expensive availability of relevant spatial data will provide the much required fillip to the use of GIS (Tosta, 1997) in various application domains. Political support to SDIs at the highest government levels in the US, Australia, and Europe has raised "the profile and importance of spatial information within

the wider society" (Williamson, 2003, p. 3) leading to similar initiatives being taken up in more than 120 countries, both developed and developing (Crompvoets and Bregt, 2003).

In this paper, we argue that the growth and utilization of (N)SDIs in developing countries is likely to be impeded for two main reasons, viz. (i) continuing techno-centric approaches in SDI design and implementation, and, (ii) vastly different contextual conditions which surround these developments vis-à-vis in the Western countries. Therefore, while adoption of SDI-based approaches is a welcome and timely initiative, its full potential can only be realized if the above-mentioned constraining factors are also effectively addressed. These assumptions provide the basis for a critical analysis of the ongoing NSDI development in India.

The rest of the paper is organized as follows. In Section 2, we briefly discuss the nature of SDIs and its constitutive components, and situate it within the historical context of geo-research and the institutional context of developing countries. In Section 3, we present the contours of the Indian NSDI initiative, and analyze it in Section 4 on the basis of the theoretical perspective articulated in Section 2. A few concluding remarks including practical recommendations are presented in Section 5.

2. SPATIAL DATA INFRASTRUCTURES (SDIs)

This section is divided in 4 parts. The first deals with the varying perceptions around SDIs articulated in the recent geo-literature. The second part discusses the influence of the quantitative turn of GIS research and practice during the 1980s (Pickles, 1995) on SDI thinking, In the third part, we discuss the more recent emphasis on inculcating bottom-up approaches in the design and use of Information Infrastructures. Finally, we emphasize the need to be sensitive to the contextual differences underlying the SDI initiatives between developed and developing countries.

2.1 Nature and Composition of SDIs

Given the relatively nascent stage and the multi-disciplinary nature of the field, "a common understanding about the nature of a SDI is still missing" (Wytzisk and Sliwinski, 2004, p. 43), and being a rapidly evolving concept there is still a "lack of definition and clarity" (Williamson, 2004). Table 1 below which provides a review of several recent definitions of SDI (compiled by Chan et al., 2001) indicates the variety of perspectives taken on SDI, and also the multiplicity of actors involved including researchers, the US President's office, the European Commission and various national and regional governmental authorities. Despite this multiplicity of perspectives, it is generally agreed that SDIs subsume technology, systems, standards, networks, people, policies, organizational aspects, geo-referenced data, and delivery mechanisms to end-users (Williamson, 2004). SDIs can thus be seen to comprise spatial datasets as well as the interrelationships between these datasets, their management, access, distribution (Scanlon, 1998), and also the organizational capacity to use spatial data (Tosta, 1994). The largely techno-centric nature of the definitions with the focus on data and standards can be seen to be broadly a common theme in contemporary conceptualizations of SDIs.

Table 4. SDIs – a few contemporary definitions

Source	Definition of SDI
McLaughlin and Nichols (1992)	Includes sources of spatial data, databases and metadata, data networks, technology (dealing with data collection, management and representation), institutional arrangements, policies and standards and end-users.
Executive Order of the US President (1994)	The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data.

Source	Definition of SDI
European Commission (1995)	Policy framework creating the necessary conditions for achieving the objectives set out. It thus encompasses all policies, regulations, incentives and structures set up by the EU Institutions and the Member States.
Australia New Zealand Land Information Council (1996)	Comprises four core components - institutional framework, technical standards, fundamental datasets, and clearinghouse networks.
Dutch Council for Real Estate Information (1998)	A collection of policy, data sets, standards, technology (hardware, software and electronic communications) and knowledge providing a user with the geographic information needed to carry out a task.
Global Spatial Data Infrastructure Conference (1999)	The policies, organizational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the global and regional scale are not impeded in meeting their objectives.
Queensland Spatial Information Infrastructure Council, Department of Natural Resources (1999)	Comprises the data sets, institutional arrangements, technical standards, products and services required to meet the needs of government, industry and the community.
Victorian Geospatial Information Strategy 2000-2003 of the State Government of Victoria, Australia (1999)	A comprehensive geospatial information resource—the infrastructure, the value and capability of which are driven into Victoria's information systems and processes—the benefit, through the strategic elements of custody, metadata, access infrastructure, pricing, spatial accuracy and awareness.
Canadian Geospatial Data Infrastructure (CGDI) (2000)	The technology, standards, access systems and protocols necessary to harmonize all of Canada's geospatial data bases, and make them available on the internet.

2.2 Historically Situating Research in SDIs

The "spatial world" of geo-informatics is populated primarily by geographers, remote sensing technologists, cartographers, GIS specialists, and image processing technologies. Several researchers (for example, Harvey, 1989; Pickles, 1995) have critiqued the "technology deterministic" focus of the geo-informatics domain, and have historically traced this focus to trends over the last three decades in quantitative geography primarily in North American Universities, and the significant role of GIS vendors in shaping university agendas. Veregin (1995) relates these trends to the crisis within the discipline of Geography in the seventies, and the pressures to establish itself as a scientific discipline. The growing use of computers has contributed to establish quantitative geography as a mainstream subject in Geography, making many of the important journals quantitative in their orientation with a strong focus on modeling.

The view of GIS as a unifying force in Geography has been criticized for the positivist assumptions it embodies, and its privileging of computing and mathematical techniques over domain related knowledge. Taylor (1990) describes this technical focus as a retreat into the realm of naïve empiricism wherein isolated facts become more important than geographical knowledge. Pickles (1995) argues that spatial technologies like GIS promote a nature of reality that is grounded in the analysis of value-neutral observation, based on science as the mirror of reality, and theory as a product of data collection and testing. Harley (1990) describes these developments as "the unconscious process of myth making, through which the invention of a progressivist, positivist past is used to justify a progressivist and positivist present."

This quantitative orientation in geography helps to understand the current techno-centric orientation of SDI with a primary focus on the technical aspects of data and standards (Williamson, 2004), deemphasizing the *context* and *process* of SDI design and use. This de-emphasis tends to mask the underlying complexity of SDIs arising from the duality of technology (i.e. both its enabling and constraining characteristics), and implications of the socio-historical-organizational context of its use. SDIs, like other IT artifacts, are not natural, neutral, universal or given but embedded materially and institutionally within a historical and cultural context. These artifacts are made up of components whose interconnections are often partial and provisional, requiring bridging, integration and articulation over time – technically and institutionally – to work together (Orlikowski, 1992).

Adopting a historical perspective helps to identify patterns in the evolution of debates around technological systems like SDIs. For example, Wilson (2000) identifies four phases of this debate: the *technological* phase which is dominated by engineers and scientists discussing technical issues adopting a technology deterministic perspective; the *journalistic* phase where the futurists tend to dominate, advancing grand visions of how information will change society: the *(empirical) social sciences* phase which advances institutional, political and distributional issues to empirically analyze questions such as who should pay for it, who owns it and how it should be operated; the *(interdisciplinary) scholarly* phase which is characterized by interdisciplinary research involving social scientists developing empirically informed theoretical frameworks. With respect to SDIs, it may be argued, that a majority of developing countries are in the first two stages of maturity emphasizing hype and grand visions over realized practical benefits, characterized by a rather weak theoretical understanding of the reasons underlying this unrealized potential.

We now discuss two sets of issues that are pertinent to the understanding of complexities associated with SDI implementation. The first concerns the need for balance between top-down and bottom up approaches to SDI design and implementation. The second issue relates to the need for sensitivity to the contextual conditions shaping SDI implementation.

2.3 Top-Down versus Bottom-Up Design Approaches

The political nature of construction and use of geographic knowledge has been historically used to wield power in various ways. For example, the detailed cartographic survey and mapping of India undertaken by the British rulers proved indispensable for "the rationalization of the extraction of surplus, administrative strategies and techniques of control" (Baber 2001, p. 44). A more recent example of the political use of such representation, made more efficient and rapid by GIS, is summarized below (The Indian Express, New Delhi, May 4, 2003):

> The new map of Jammu and Kashmir recently released by the CIA significantly describes the region east of the Line of Control as 'Indian State of Jammu and Kashmir' while it designates the territories to its west as 'Pakistan-controlled areas of Kashmir.' In the past, the US treated the whole state as disputed. There are other notable changes from the past which would no doubt make many people wonder at the political signals implicit in the map. The importance of this issue lies in the fact that the current map would have undergone rigorous inter-agency examination in the US system, and after approval at the highest levels, now depicts the official government position in the map which would be used by everyone in official and unofficial circles in the United States and its allies.

The ability to spatially represent and analyze information inherent in GIS manifests power and authority (Wood, 1993) in the hands of the concerned technocrats and administrators (Weiner et al., 1995), making the notion of an "objective GIS" fundamentally problematic (Harris et al., 1995). This expert and administrative power renders GIS designs being "top-down" with little or no involvement of the end-users. As emphasized by IS and GIS research, the lack of user participation often leads to "failures," as the systems are not effectively integrated into the work routines of the recipient organization (Walsham & Sahay, 1999), adversely influencing capacity development at the local level.

This top-down philosophy of the GIS domain was carried forward in the design of the first generation (N)SDIs. Although there have been some shifts to a more user-centered approach in SDI design in Western

countries, the techno-centric still is predominant, especially in the context of developing countries like India (Georgiadou, 2003). Learning from the experiences of developing first generation SDIs (Masser, 1999), the present approaches acknowledge that "SDI is all about facilitation and coordination, which is fundamentally about people" (Rajabifard et al., 2003), with arguments being advanced for inculcating more socio-technical approaches (Reeve & Petch, 1999).

Groot and McLaughlin (2000) argue that a careful, mutually reinforcing combination of top-down and bottom-up approaches is required in (N)SDI design. The top-down approach, adopted within an institutional framework, should be concerned with specifying a strategic goal and vision, prioritizing and developing implementation plans, and arranging for core funding. The expected outputs from the top-down planning comprise (i) defining fundamental geospatial datasets, (ii) building clearinghouse mechanisms, (iii) developing metadata standards and access protocols, and, (iv) resolving information policy issues. The bottom-up approach, on the other hand, promotes various local initiatives and the building of application-specific and enterprise-wide geospatial databases. This should be seen more as an evolutionary approach to accessing, combining and using data though user-centric methodologies such as prototyping, and cultivation of standards. The bottom-up approach, in contrast to the top-down approach, can potentially contribute to capacity building at the local/institutional levels.

2.4 Contextual Differences – Developed versus Developing Countries

SDI/NSDI agendas are shaped by the contextual conditions of individual countries. In the United States, for example, the public's "right to know and access to information is reinforced by the belief that the public has paid, through taxes, for the collection of government information" (Tosta, 1997). The citizens are thus acknowledged to be the owners of all such information, and the US legal framework provides for enabling mechanisms that require government agencies to make available information desired by the civil society. The cost of this access is supposed to be equivalent to that of reproduction, if not free, except where confidentiality or privacy laws apply (Nedovic-Budic & Pinto, 2001). This policy of open access and low-cost availability of geospatial data has encouraged the development of a robust private sector (Weiss, 2004), and a greater participation of civil society in the US NSDI initiative.

In the European Union, the European Commission decided in July 2004 to submit to the European Parliament and the Council of the European Union the proposal for a Directive[1] for an Infrastructure for Spatial Information in Europe (INSPIRE Directive) in support of both national and community environmental policy and to enable the public to access this information. The proposed Directive creates a legal framework for the purpose of formulating, implementing, monitoring and evaluating community policies at all levels and providing public information. An extended impact assessment quantified environmental benefits of INSPIRE in 2002, an extensive stakeholders consultation on the internet was conducted in early 2003, followed by a public hearing in Rome in July 2003 (see http://inspire.jrc.it for further details)

In most developing countries, where SDIs are currently being actively promoted through the efforts of international agencies and also national policy makers, often very different contextual conditions influence their uptake. For example, security concerns have led to control over spatial data by the defense establishments (Fox, 1991), severely restricting civil society's access to maps, and deeply mired in bureaucratic procedures making (Sahay & Walsham, 1996). Such restrictions run contrary to the aims of SDIs to make spatial data freely and easily accessible to all stakeholders in civil society.

The key arguments made in the two points above are summarized in Table 2 below.

Table 2. Summary of arguments around SDIs

Relevant issues identified
SDI is an evolving technology, with varying perspectives and definitions;
Techno-centric perspective is emphasized in SDI conceptualization, particularly in developing country contexts;
Top-down approaches to design and implementation of (N)SDI arose from historical contexts in which the positivist GIS philosophy was grounded (during the 1980s and early 1990s). These inhibit capacity development;
Lately, however. socio-technical thinking around GIS/SDIs is increasingly discernible in the Western contexts; viz.: - local level development and use emphasized (local through state, national, regional and global); sharing and exchange of spatial data among stakeholders from different jurisdictional levels essential; - NSDI stresses partnerships – can only be realized through cooperation among local, state, national levels; academia involvement and research within national contexts essential; - Capacity building subsumes institutional and human factors;
A weak data sharing culture adversely impacts users' capacity enhancement, especially in developing countries;
The resulting scientific and technical elitism around GIS tends to be perpetuated and even magnified in the SDI domain in developing countries.

The above summary provides us with a conceptual lens to analyze the ongoing approach to developing NSDI in India in Section 4. We first present the case description in Section 3 below.

3. THE INDIAN NSDI

In this section, the conceptualization, planning and implementation status of the Indian NSDI is summarized. The description is developed mainly through the examination of secondary data, including NSDI related documents and conference presentations, informal meetings with concerned officials over the last three years, and some focused interviews with current players in the national task force in 2004.

3.1 Background

Planning for establishing a National Spatial Data Infrastructure commenced in November 2000 with the setting up of an NSDI task force to prepare a viable strategy and action plan for this initiative (Department of Science and Technology (DST), 2001). This initiative stems from discussions among the DST and Indian Space Research Organization (ISRO) scientists, with quite an explicit aim to emulate Western NSDI programs.

The task force was composed of geographers, scientists, GIS experts and administrators, mainly drawn from survey, mapping, space and remote sensing organizations (Department of Science & Technology, 2001, p. Tf.1). The potential users (for example, environment, rural development, health, urban development, or grass-root organizations) of the proposed NSDI were not represented. The discussion document prepared by this team, which constituted the basis for further action, identified the following key elements: the development of standards (to allow interoperability; standards for networks, gateways, protocols, software etc.), evolving metadata, establishing nodes (GIS-based spatial database servers), creating search and access protocols, establishing an electronic clearinghouse for spatial information, creating user interfaces, and initiating an NSDI outreach and awareness program.

3.2 Structure of the Proposed NSDI

The available framework and thematic spatial data are proposed to be digitized and made available to the NSDI users through "a national repository of a digital "warehouse"" (Department of Science & Technology, 2001, p. 3.1). Twelve map series identified for this purpose are either on 1:50000 or smaller

scales. These comprise topographical, geological, soil, vegetation cover, groundwater potential, land use, and wasteland maps etc., national atlases on 1:1000000 scale, and satellite images.

The Indian NSDI has been conceptualized as an "overarching framework over existing agency-efforts at spatial information generation and format conversion" (Department of Science & Technology, 2001, p. 4.1). The Chairman of ISRO (2004) visualized the approach to its implementation in the following words. "...ISRO, along with the DST, is the main architect of India's National Spatial Data Infrastructure (NSDI), especially in conceptualizing the NSDI, developing standards for metadata, content and design, *developing solutions and applications...*" (emphasis added). On conclusion of the 3rd NSDI review meeting held at Agra in 2003 (http://www.nsdiindia.org/publication/), the development of NSDI was described as "another Taj[3] in the making," to metaphorically reflect the rather grandiose and top down nature of the vision.

The NSDI is to be implemented on GIS database servers, the present plan being to equip each participating institution with one "NSDI node" (Department of Science & Technology, 2001, p. 4.7). Geospatial data holdings relevant to and produced by individual institutions are to be stored on these servers. For example, the vegetation cover maps of the country (on 1:50 000 and 1:250 000 scales) would be maintained on the Forest Survey of India's server, while the Survey of India node would be the repository of the topographic data. All these servers will be interconnected, also to a "master" NSDI server over an intranet. The "master" server is expected to function as a gateway to the Internet, also as the electronic clearinghouse, with data access from other nodes being allowed based on access protocols. The master server is also expected to function as the metadata server.

3.3 Sources of Spatial Data

The Indian national mapping organization, known as the Survey of India (SoI), was established in 1767. Its assets include the national spatial reference frame and topographical maps, at scales of 1:25 000, 1:50 000 and 1:250 000. These maps provide the base for the preparation of thematic maps by user agencies. A Digital Cartographic Data Base (DCDB) was introduced in the 1980s to facilitate updating of maps, and the digital vector data exchange format was adopted in 1992 (Srivastava, 2000). The 1:250 000 scale maps for the country have since been digitized, while the digitization of 1:50 000 scale maps is currently in progress. However, digital maps, containing the full content of conventional topographic maps were found to be too complicated, out of date, and badly structured to be of immediate use to the users in the government, the private and NGO sectors (Georgiadou, 2003).

An indicative summary of some of the spatial data available with various agencies is summarized in Table 3 below.

Table 3. Indicative summary of spatial data holdings in India

Owner institution	Map series	When created	Scale	For what purpose
Survey of India (SoI)	Topographic maps	At various times	1:50 000, 1:250 000 1:25 000@	Topographical framework data; also the base for preparing thematic maps
Ministries of Environment & Forests, Rural Development (in technical collaboration with Prepared by NRSA, SoI.	District-wise wasteland maps	1985-1999	1:50 000	Prepared by NRSA, SoI. Projected use: identifying location of wasteland (village-level) for development.
Planning Commission	District-wise land use	1993-1999	1:250 000	Obtain State/country-wide land use statistics for planning purposes
National Bureau of Soil Survey and Land Use Planning.	Soil maps series	1990s	1:250 000	Soil mapping to assess soil degradation.

[3] The famous Taj Mahal, one of the 7 wonders of the world, is located in Agra (India).

Owner institution	Map series	When created	Scale	For what purpose
Forest Survey of India	Vegetative Cover	1987-	1:250 000	Assessing vegetation cover; conducted every 2 years.
Indian Space Research Organization (ISRO)	NNRMS* maps and digitized coverages	1983	1:500 000	Watershed prioritization at state level based on severity of land degradation and other related factors (for allocation of funds); to support GIS-based studies for land/water management (micro-watershed level). Implemented in 30+ districts.
Department of Science & Technology (DST)	NRDMS* maps and digitized coverages	1982	1:50 000	Pilot studies to develop GIS-based methodologies for land/water management. Implemented in 45 districts.
Department of Space	IMSD*	1995-	1:50 000 1:250 000	Addressing land degradation and augmenting water availability in arid, semi-arid regions. GIS modeling used to prepare intervention plans in target areas. To cover 175 districts in due course (about 24% of country's land area.

@For about 35% of the country so far.

*National (Natural) Resource Management System (NNRMS), Natural Resource Management System (NRDMS) and Integrated Mission for Sustainable Development (IMSD) are *separate* programs of the mentioned central government departments, albeit with overlapping objectives, often implemented in the same district.

+There are over 500 districts in the country.

3.4 Public-Private Sector Partnership

While there have been some signs of increasing private sector involvement in the Indian NSDI, it appears that the decision making power continues to rest in the hands of the scientific institutions. In a recent interview with one of the private sector players involved with the task force, we were told:

> The scientific institutions are still contesting who should be in charge. Each is saying that "they are the SDI" rather than discussing how they can facilitate the establishment of an effective SDI.

Security concerns and the strong control of maps by the defense establishments were also identified as major impediments to the efforts. The strategy of the scientific institutions to date has been on "making the data available on the internet, and then the users will follow." This kind of "data push" strategy is currently being implemented by the institutions by attempting to create a web portal to place the map layers so that they can ultimately be made available to whoever needs them. A senior scientist of the task force justified the data push strategy by arguing that only when the Internet was made available the public started to find ways to use it. Currently, access to the prototype SDI is not open as it has been hosted on an intranet, and also the applications are being developed on the ESRI platform rather than some open source platform which may potentially open up the possibility of a larger user base. The end users, for example the district administration or particular departments like health, education are currently totally excluded from the processes by which decisions are made over the design and implementation strategy.

Another large private sector player also indicated his frustration with their unsuccessful efforts to get maps from the government agencies, and being forced to make significant corporate investments to purchase the

satellite images from North America to develop their own geo-database for the whole country (consistent with its long-term telecommunication marketing strategy). A senior manager from the organization also commented on the problems of providing broader access of this database to other organizations. He said: "unfortunately they (external organizations) cannot (access their database), since there are no mechanisms available to them due to government restrictions to make these maps available commercially to users outside the corporation."

The examples above gained from some initial preliminary players involved in the SDI efforts indicate the challenges being faced, which reflect tendencies similar to the GIS implementation efforts since the early nineties (Sahay & Walsham, 1996).

3.5 Summary

The plans and progress of implementing NSDI have been regularly discussed and reviewed in NSDI workshops organized by the task force. While some of the key decisions taken in three workshops held so far (2001-2004), (summarized in Table 4), reflect the techno-centric nature of the current process, there may be some potential for change arising from the increased emphasis on building public-private partnerships. However, it is likely that this may introduce other challenges, such as in the definition of the commercial value of the maps which till to date have technically been treated as "public goods" under state control.

Table 4: Current status of the Indian NSDI

Subject	Decision/current status
Formalizing metadata	Metadata version 3.0 and data exchange standard version 1.1 have been adopted. Participating agencies (responsible for generation of spatial data) to systematize their data holdings and to develop metadata for these as per these standards. Private sector companies in India representing ESRI, Rolta etc., have also been requested to adopt these standards in their solutions and services.
Encouraging private sector participation	An active role of the private sector is foreseen by way of providing IT solutions, services, training, and placing its spatial data holdings within the ambit of the NSDI.
Providing access to topographic maps to civil society (hitherto restricted)	Survey of India has been asked to prepare a "civilian" version of its topographic maps by eliminating geographical features and other information considered "sensitive." These "sanitized" versions may be made accessible to the civil society in due course, although a clear-cut policy in this regard is yet to be formulated.
User requirements	Visualized as *yet another driver of NSDI*. Therefore, the task force *could* undertake specific need assessment of the potential applications of NSDI. Private sector would also be involved in assessing user needs and developing applications.
Sourcing large scale spatial data	Spatial data available in larger scale maps needs to be included in the NSDI. However, locating, and standardizing these datasets will require further studies as many of these maps are not based on the spatial framework specified by the Survey of India.
Technical and administrative powers	NSDI should function as an "empowered apex authority" invested with powers to formulate, and ensure compliance to, spatial data related policies in the country. The policy framework to include design and implementation of NSDI servers, specifying spatial data quality, evolving standards (including metadata specifications), formulation of rules and procedures for allowing data access and participation of other agencies in the NSDI. The envisaged role of the NSDI, its broad policy and operational framework, are to be given a formal high-level status through an enabling legislative mechanism to be brought before the Parliament, leading to the establishment of a National Spatial Data Commission (Matthan, 2003).
Locating financial resources	The Commission would make proposals to the government to seek financial allocation for operationalizing the NSDI, besides seeking to establish public-private partnerships, and soliciting international loans/aid. An approximate estimate made by the task force anticipated an expenditure of US $40 million to bring the *existing* data holdings alone within the ambit of NSDI.

Source: Minutes of the NSDI review meetings: available on http://www.nsdiindia.org/publication/

4. DISCUSSION AND ANALYSIS

Relevant issues with regard to the development of SDIs, especially in developing country contexts, identified through a survey of relevant literature, were summarized in Table 2. We now draw upon this framework to analyze the planning, design, and implementation around the Indian NSDI.

4.1 Conceptualizing, Designing and Implementing NSDI

The use of GIS by public sector agencies in India (also in many other developing countries) has been characterized by top-down approaches to application design, lack of user participation and the domination of technological deterministic approaches (Sahay & Walsham, 1997; 1997a). Several contributing factors include the weak capacity in organizations to harness ICTs in their work routines outside of select scientific and technical institutions, absence of an effective policy framework to augment this capacity in a systematic manner to meet both immediate and long-term needs (ibid.). These tendencies are reflected in the NSDI arena as well, and, we argue, are further reinforced because of the dominant focus on data and the current primary role of the national scientific institutions in defining the NSDI agenda.

The Indian NSDI case description reflects the absence of user representation on the task force, as well as the lack of consultative processes with them. Its conceptualization, design and implementation have been largely confined to the domain of ISRO and DST scientists, reflecting a standard task-technology model" of ICT development for workplaces (Kling et al., 2000). The ontological basis underlying such an approach is the adoption of an "explicit view of work" where user needs are assumed to be identifiable by what is visible and documented, and a technology deterministic view which holds that people will adopt the technology only because it is made available to them in a technological sense. The NSDI reflects broadly this top-down as well as data-centric approach (Georgiadou, 2003). The desirability of appropriating bottom-up and user-driven approaches (Groot & McLaughlin, 2000) (sub-section 2.3 above) has not been explicitly considered by the planners, and user departments are strikingly absent from the planning process.

4.2 Absence of Socio-Technical Perspectives

Information Systems research has over the years increasingly emphasized that people and organizational aspects are as important as the technology related components. This research has contributed to the more widespread adoption of socio-technical approaches while planning ICT-based systems and infrastructures within or across organizations. For example, Hanseth (2000) describes information infrastructure as a complex web of intertwined information systems, subsuming human, social and technical components that develop over time. Drawing upon structuration theory (Giddens, 1984), Orlikowski (1992) describes technology to be a malleable structural property of an institution. She argues that organizational intentions and values by themselves do not drive a given technology or predict its impacts. These impacts are mediated by human actors in unpredictable ways during different phases of a technology's trajectory (viz. its conceptualization, design implementation, use, modification etc.). This thinking emphasizes the need to examine technological and organizational characteristics together rather than in mutual exclusion. Kling et al. (2000) underscore that in contrast to standard task-technology models, socio-technical network approaches adopt a tacit view of work, underscoring, for example, work practices, a conceptual understanding of actors involved, and that "configurations matter and interact with human activities, such as work" (p. 46). The emphasis of these approaches lies in improving work practices and on understanding how collaborative learning takes place. Skill development takes precedence over improving efficiencies.

The socio-technical design approaches are not yet evident in the Indian NSDI case and end-user participation is nearly non-existent. As a result, the ability of end-user organizations to meaningfully apply spatial data in their specific application contexts is unlikely to be enhanced, thereby defeating the *raison d'être* for the NSDI. Since such an infrastructure is large, layered and complex, and "because it means different things locally" (Star, 1999, p. 382), its successful development can simply not be top-down, but must necessarily involve negotiations among different stakeholders to accommodate their competing interests.

4.3 Lack of Data Sharing Culture

Impediments to data/information sharing, magnified in the case of spatial data, among organizations arise more from behavioral rather than technical factors (Croswell, 1989; de Montalvo, 2002), manifested at individual, organizational and inter-organizational levels (Pinto & Azad, 1994). Inter-organizational information sharing may be facilitated through the pursuit of a common overriding objective (Pinto & Onsrud, 1995), and/or also enabled through negotiation (Obermeyer, 1995). In India, and in many developing countries, the culture of data/information sharing is weak due to security considerations (Fox, 1991), poorly understood technical issues (Nedovic-Budic & Pinto, 1999), and government departments operating in compartmentalized and fragmented ways. For example, the three GIS-based databases aiming at local area development alluded to in Table 3 above (viz. NNRMS, NRDMS and IMSD), despite being inspired by largely common objectives and data sources related to natural resources, continue to develop their own databases with little efforts to share and coordinate within a common NSDI framework. Apart from contributing to a duplication of scarce resources, the lack of sharing culture also inhibits capacity building to use spatial data. In addition, NSDIs bring in other technical complexities and institutional issues such as related to intellectual property rights and investment of significant financial resources (Rhind, 1999; 2000). These potentially thorny issues have not yet been seriously considered by the NSDI planners.

4.4 Scientific/Technical Elitism

In India, where science and technology enjoy a higher status than arts and humanities, GIS scientists tend to look down upon the users and their lack of scientific knowledge (Sahay & Walsham, 1997). The power arising through this "possession" of technical knowledge is often further magnified by the institutional politics, and a rational education process which emphasizes technical skills development over the social sciences (Nair, 1997). Therefore, promoting critical perspectives in the design and implementation of NSDI are difficult to bring about in practice due to complexity in changing the historically existing attitudes of superiority of the scientists in charge of the NSDI. We argue that unless the elitist trends are redressed, and the debate around the design and use of NSDI is widened, the promised potential of SDI will remain elusive and difficult to achieve in practice.

5. CONCLUDING REMARKS: SOME SUGGESTIONS FOR THE WAY FORWARD

We have analyzed some key shortcomings around the vision, design and proposed practice of the Indian NSDI initiative. While the move for developing the Indian NSDI is a timely endeavor, we argue for its reorientation to accommodate socio-technical and bottom-up paradigms. We make the following suggestions in this regard.

Firstly, a layered approach to the SDI development needs to be adopted. For example, the existing NNRMS, NRDMS and IMSD programs, which have been under implementation in selected areas for more than 10 years, need to be reviewed to address their weaknesses. These initiatives need to be embedded more firmly in the local work practices through focused attention to capacity building, and extension of their coverage to other districts. A practical approach may be to reconfigure these separate programs as strategic information systems to support sustainable development in India over time (Talero, 2000). Not only does this shift requires a harmonization of their disparate datasets, but also coordinating the scope, importance, budgets, deadlines, public accountability criteria, and responsibilities of these various programs (ibid.). Such technical and institutional integration would not only strengthen the field programs, reduce redundancies, but would also provide a learning platform for inter-departmental cooperation in data sharing, and establish a firmer foundation for the NSDI to develop a culture of "information" and "knowledge" management.

Secondly, the existing policies that inhibit access to maps and other sources of spatial information by the civil society need to be urgently and realistically reviewed. This is not to make a case for diluting national security concerns, but a call to take into consideration the advances in technology since the present policies, a legacy of the British era, were formulated. The continuation of such an outdated framework in the wake of existing space-related technologies represents an anachronism. A better informed policy and simplified procedures are also expected to promote public-private sector partnerships. An encouraging development

in this direction was the announcement of Minister of State for Science & Technology and Ocean Development, at a meeting with Geoinformatics Industry, on 28th July 2004, in New Delhi that India will have a new mapping policy in the next six months (http://www.spacedaily.com/news/india-04m.html).

Thirdly, the debate around NSDI, its design and implementation needs to be opened up by fully involving user and field-level organizations (like the district rural development agencies) in these aspects. In a country of India's size, physical and cultural diversity, "ownership" of the NSDI by a few scientific institutions alone is unlikely to yield a workable or acceptable spatial information infrastructure. This task needs to be decentralized and progressed in consonance with the capacity of the users. Recent theoretical and empirical research reported in relevant literature emphasizes that "The essence of GDI [SDI] concept is that there is no master architect" (Groot, 2003, p. 27) and that "Nobody is really in charge of the infrastructure" (Star, 1999, p. 382).

Fourthly, SDI implementation needs to be considered simultaneously with the development of human resource capacity. Meaningful application of spatial data will only be marginal if there is a limited culture to use maps at both institutional and individual levels. Human resources capacity development thus needs to go beyond merely providing technical skills to use software, but to developing a strong spatial awareness and a capacity to formulate existing problems in spatial terms.

NOTES

[1]A Directive is an EU law that takes legal precedence over the laws of individual member states. All Directives must be voted into existence by the appropriate Council of Ministers after consultation with the European Parliament. Once adopted, they normally provide for a period of two or three years for introduction into the laws of member states.

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Justifying the Modification of Technology Acceptance Model to Match Realities in Developing Countries

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ABSTRACT

Given the globalization of the world economy, Sub-Saharan Africa is expected to play greater roles than it has in the past. The motivation for this paper is to enhance our understanding of the interactions that come to bear between some socio-economic development needs and factors generally innate to sub-Sahara Africa and other developing countries; these manifest to impede technological adoption in the regions. This research is an extension of the influence of perceived user resource, which in turn was developed from the original TAM literature; it also extends ideas espoused in Information Technology literature on socio-economic development. We validate the model by analyzing survey data gathered in two representative Sub-Saharan African countries. We offer some diagnostics and prescriptions for how to effect a sustainable technological adoption and development across the region. We believe that our presentation would bring Sub-Saharan Africa and other developing regions that are almost non-existent in mainstream MIS research into focus.

Key Words: Accessibility, Sub-Saharan Africa, Socio-economic Development, Precursors to Accessibility, Technology infrastructure, Positive-impact Factors, Negative-impact Factors, Partial Least Squares (PLS), Path Coefficient, Modified TAM.

INTRODUCTION

While there has been considerable research on innovation adoption and diffusion especially in the rapid growth area of Information Technology, most has focused on developed countries (Mathieson et al., 2001; Straub, 1994; Gallivan, 2001). Most of technology adoption research presumes that technology is readily available, and the onus of accepting or rejecting it resides with the end user. However, this assumption falls short of realities in developing countries such as those in Sub-Saharan Africa. Countries in this region lag behind the rest of the world in basic socio-economic factors such as income, education, health, productivity, etc., all of which are pertinent to the day-to-day use of modern technologies (Mbarika et al., 2002).

To the vast majority of potential users in developing countries, adoption is not about choice, since universal access to technology is not available. It is noteworthy here that much of the IT infrastructure in sub-Saharan Africa is concentrated largely in metropolitan areas that account for less than 30% of the region's population. Furthermore, only a select few of those living in the metropolitan areas have access to information and communications technologies (ICTs), hence exacerbating the problem for what is recognized as the least developed region of the world. Given this scenario, it is no wonder that when it comes to Sub-Saharan Africa, ICTs are considered luxury items affordable only by the "bourgeoisie" (Ansah, 1985; Mbarika et al., 2002).

Despite the plethora of models and studies on technology adoption in mainstream IS research, there are little or no known studies that examine technology adoption and the precursors thereof within the sub-Saharan African context. Several researchers have also reported that the original technology adoption model and other revised versions omit variables that may be important predictors of usage (Mathieson et al., 2001; de Vreede et al., 1999; Malhotra and Galletta, 1999). This paper seeks to develop an extended technology acceptance model that accounts for some technology adoption dynamics and precursors that come to play in the context of Sub-Saharan Africa. Our study builds on the works of other researchers that have made notable contributions to the field of information technology adoption and socio-economic development (e.g., Davis, et al., 1989; Mathieson, et al., 2001; de Vreede et al., 1999; Malhotra and Galletta, 1999; Madon, 2000). One of the contributions we make in this research is to extend the TAM model to account for cases where potential users face inadequate accessibility and exposure due to non-availability of technology resources or other reasons. Another contribution is that we explore the factors that contribute to the perpetual inadequacy of modern technologies in developing countries, particularly Sub-Saharan Africa (by merging TAM with socio-economic/human development literature). A third contribution we make relates to policy prescriptions of how best to effect a systematic development of infrastructure that leads to sustainable socio-economic development and requisite technologies that support the needs of a developing region. Why is technology adoption important for sub-Saharan Africa and other less developed regions? It is partly because adequate adoption allows a country to realize the impact of technology. At the end of the day, it is the impact of ICTs that is of most importance. Ultimately, it is the positive impact on human development that we seek to accomplish using ICTs and other means. Some questions that motivated developing this paper include:

RQ1: Does an individual's perception of the socio-economic environment influence their accessibility of information technology?

RQ2: Is accessibility of technology a precursor to an individual's adoption of a new technology?

RQ3: Does sudden exposure to modern information technology lead to adoption?

Based on how technology has evolved over time in developed countries, and the importance of learning curve, we posit that access and exposure to basic forms of technology over a period of time allows for a much easier progression to and acceptance of modern types of technologies. The implication to developing countries is that everyone is telling them to jump on the technology superhighway band wagon, or be doomed. But technologies are not artifacts that could be adopted immediately by all of societies regardless of historical, cultural, or socio-economic conditions. What further complicates the matter for Sub-Saharan Africa and other developing countries is that access to even the most basic of technologies largely remains a dream. What they yearn for is infrastructure for socio-economic developments, from which access and exposure to more modern technologies would follow. While we recognize the important role that ICTs play in today's world, we call attention to the evidence that point to the failure and waste which often results from sudden massive transfer of ICTs to a developing region with initial hopes of igniting the engines of social development (Odedra-Straub, 1996; Morales-Gómez and Melesse, 1998; Madon, 1999, Sein and Ahmad, 2001; Sein and Harindranath, 2004). From our discussions, it would seem reasonable that we should not simply extrapolate the existing variations of technology acceptance models or experiences from the developed nations of the world to apply to Sub-Saharan Africa without accounting for various local circumstances.

While we do not claim that there is a complete unlimited access to technology for those who live in developed countries such as the United States, it is hard to deny the relative ease of outright ownership or access to ICTs by those who live in developed countries through various means such as public libraries, schools, hotels, recreation centers, work places, etc. The level of socio-economic development and

sophistication in the use or application of the ICTs is also much higher in developed countries because they have had years of exposure to technology, going back to the most basic forms. The situation that prevails in a region such as Sub-Saharan Africa that has battled with a long history of deprivation in the most basic amenities is understandably different.

NEED FOR NEW TAM MODEL FOR DEVELOPING COUNTRIES

Several theoretical frameworks have been used to explain innovation adoption. Among them are the theory of planned behavior, theory of reasoned action, diffusion of innovations, social cognitive theory, technology acceptance model, etc. (Gallivan, 2001). An area of innovation adoption and diffusion that has received considerable attention, especially in Information Technology, is research that predicts whether individuals will accept and voluntarily use a given technology. One of the most referenced models in this research stream is the Technology Acceptance Model (TAM). TAM proposes that successful adoption (acceptance) of technology is dependent on its usefulness and its ease-of-use (Davis, et al., 1989).

Researchers have studied TAM from various perspectives. One perspective looks at the influence of perceived user resources (Fishbein and Ajzen, 1975; Mathieson, et al., 2001). The Perceived User Resource (PUR) model or extension of the original TAM model accounts for the user's perception of the relevance or adequacy of a given technology. Pursuing this extension of the TAM framework, we desire to analyze situations prevalent in countries or regions of the world where technologies are not readily accessible. Such situations are reminiscent of developing regions of the world, such as Sub-Saharan Africa. For example, out of the 690 million people in the region, a paltry 150,000 (or 2 out of 10,000) people had Internet dialup access in the year 2001 (Jensen, 2001).

THE INFLUENCE OF PERCEIVED USER RESOURCES IN TECHNOLOGY ADOPTION

This paper is an extension of "The Influence of Perceived User Resources Model", which in turn is an extension of the original Technology Acceptance Model. Continuing along the genealogical lineage, TAM's roots come from the Theory of Planned Behavior (TPB), which came from psychological research in the area of the Theory of Reasoned Action (Fishbein and Ajzen, 1975; Mathieson, et al., 2001).

Unlike the theory of planned behavior, TAM was developed to study the decision-making processes of users as to whether or not to adopt some information technology in various settings. Certainly, TAM has made major contributions to the field of Information Systems. A major reason for TAM's popularity is its practicality (relative to TPB). It is more parsimonious than TPB. Unlike TPB in which every situation requires unique operationalization, calling for the development of customized instruments for behavioral, normative, and control beliefs, TAM does not require such. Also, TAM has less constructs than TPB, making it easier to apply when predicting IS usage (Mathieson, et al., 2001).

In spite of its relevance and practicality, the original TAM model has some potential limitations when it comes to Sub-Saharan Africa. For example, TAM was based on studies in industrialized countries where accessibility to technologies already existed. When it comes to Sub-Saharan Africa where technology availability is grossly inadequate, using the TAM model in its original form would be a stretch.

THE PERCEIVED USER RESOURCES MODEL

In developing a more appropriate model for Sub-Saharan Africa and other less developed countries, we start from the perceived user resource model (PUR) proposed by Mathieson, et al. in 2001. The justification for focusing on and extending from here stems from the fact that the perceived user resource model already extends the original TAM model to account for users' perceptions of the resources at their disposal. From here, we now develop a new model that explicitly recognizes the non-availability of technology in certain regions of the world. A detailed theoretical discussion of the perceived user resource model will not be presented in this paper, as that has already been presented by Mathieson, et al., [2001].

The Mathieson model which focuses on resource issues is shown in Figure 1. The rationale for focus on resource issues was based on the belief that it allows researchers, policy makers, and private investors a better delineation of factors over which managers may have some degree of control. It also helps keep the construct distinct from previously created constructs that deal with perceptions of users' abilities such as self-efficacy and skill (Compeau and Higgins, 1995; Mathieson, et al., 2001).

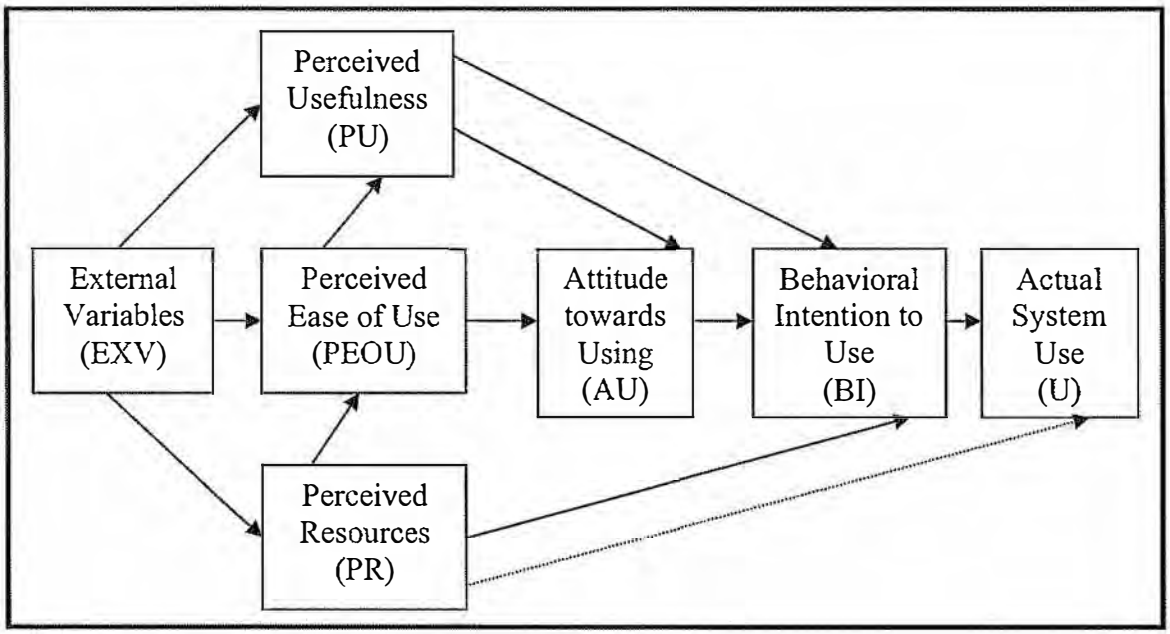

Figure 1: Influence of Perceived User Resource Model Extension from TAM

[Adapted from Mathieson, et al., 2001]

In the Mathieson model (Figure 1), perceived user resources is designated by "PR", which is the extent to which an individual believes that he or she has the personal and organizational resources needed to use an Information System. The perceived user resources include factors such as skills, human assistance, hardware, software, time, documentation, and money (Mathieson, et al., 2001). In actuality, the factor "PR" is made up of reflective and formative components. The reflective component measures an overall perception of resource availability, while the formative components measure the perceptions of individual resources, such as expertise, training, hardware, money, etc. Since these items capture different resources, they are not necessarily correlated (Mathieson, et al., 2001). Previous research papers show that perceived usefulness and perceived ease of use are both predictors of technology adoption by individuals, with perceived usefulness being the stronger of the two (Davis, et al. 1989; Gefen and Straub, 1997; Gefen et al., 2003; Grover and Ramanhal, 1999; Malhotra and Galletta, 1999; Mathieson, et al., 2001; Venkatesh and Morris, 2000).

We chose the Mathieson model as a logical point from which to develop and launch our model because it is already resource-oriented. The model we develop shows interactions between socio-economic development and accessibility to technology in less developed countries. We also point out the effects of what we call negative and positive impact factors to development, and account for them in our new model.

THE REVISED TAM FOR SSA: ACCOUNTING FOR ACCESSIBILITY AND EXPOSURE TO TECHNOLOGY

Our extension of TAM model for SSA accounts for the accessibility and exposure (or lack thereof) to information technology, and is given in Figure 2. The new model incorporates the linkages between factors of national development (socio-economic development) and technological infrastructure (as captured by accessibility to technology). The model also captures individuals' perceptions of the negative and positive impact factors that will be discussed shortly. Before we present the validation of the new model, we first give a discussion of and rationale for its constituent parts.

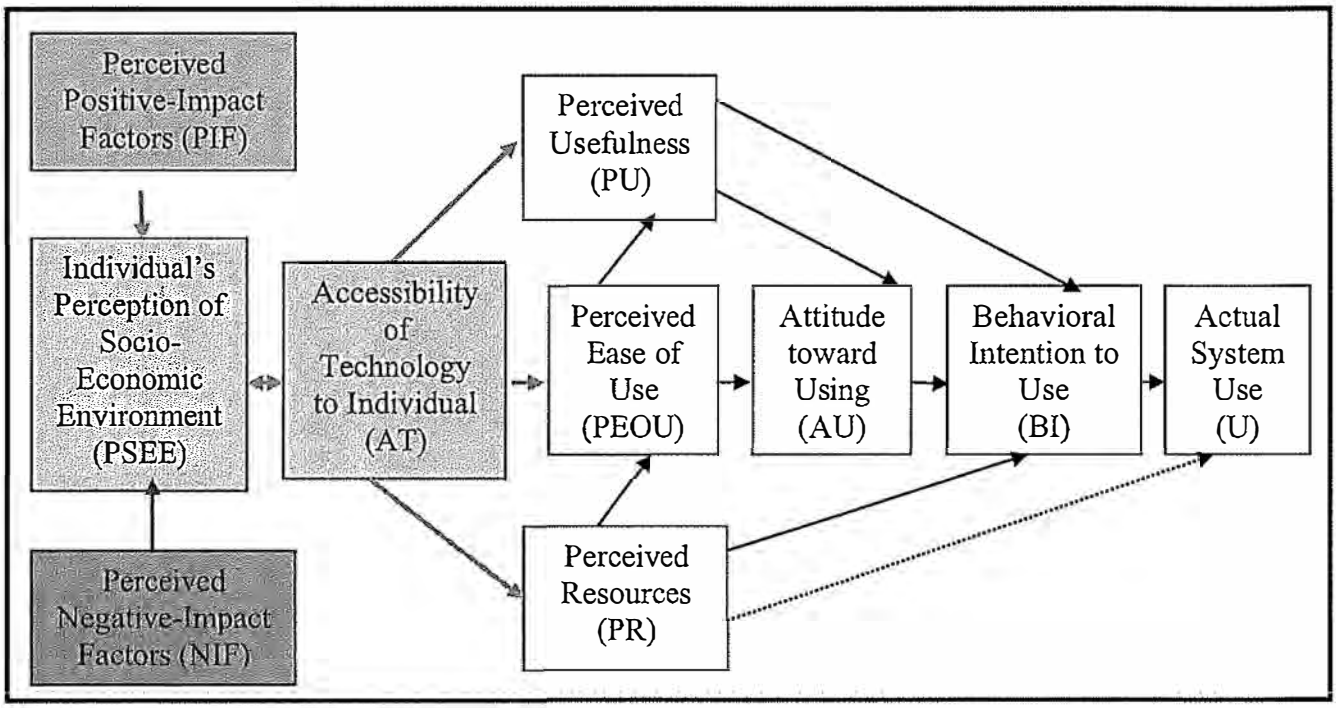

Figure 2: The Revised TAM for SSA: Accounting for Accessibility of Technology

NEED TO ACCOUNT FOR ACCESSIBILITY AND EXPOSURE TO TECHNOLOGY IN TAM

The "Accessibility of Technology to Individual" in the new model shown in Figure 2 refers to the technology that is in place and available for use. This would include related ICTs such as computers, telecommunications networks, Internet, or any machinery or equipment that constitutes "a technology" in a user's world. Of relevance here is the fact that merely having access to technology is one thing, but the maturity and exposure of a user in the use of related technologies over time as well as the existence of appropriate technological infrastructure in a given region significantly helps users to put a given technology to its full potential. In a 2004 study, it was reported that despite the proliferation of cellular phones across Sub-Saharan Africa in recent years, most of the use is limited to socialization and status symbol, with little or no business application such as M-Commerce (Meso, et al., 2004). This underscores our call for systematic exposure rather than sudden overdose or inundation by technologies without the supporting infrastructure, proper learning curve, relevance, or education to make it sustainable or meaningful.

As indicated in our new model, they impact the object labeled "Individual's Perception of Socio-Economic Environment". The positive impact factors are a collection of factors that tend to nudge a nation towards making substantive improvements in its socio-economic development in various areas such as: health, democracy, good governance, economic productivity, social well-being, the physical environment, roads,

water and power supply, education, employment, pressure or desire to integrate into the world economy, etc. (Musa, et al., 2004; Meso and Duncan, 2000). On the other hand, the negative impact forces include: lack of vision, bribery and corruption, lawlessness, military and civilian dictatorships, investments in obsolete or hand-me-down technologies, apathy, colonial master-plans, religious/tribal strife, minimal efforts to provide the populace with the basic amenities in life such as water, roads, electricity, healthcare, education, employment, etc. (Musa, et al., 2004; Meso and Duncan, 2000).

INTERACTION BETWEEN SOCIO-ECONOMIC DEVELOPMENT AND ACCESSIBILITY

As noted in the diagram, there is a two-way interaction between "Individual's Perception of Socio-Economic Environment" and "Accessibility of Technological to Individual". We believe that the chicken-and-egg analogy applies here. We suggest that basic technology (those that support farming, healthcare, education, etc.) provide the initial jolt in the positive feedback loop between the two. Ceteris paribus, the initial introduction of appropriate technology serves as a catalyst to socio-economic development. From here, national governments, international agencies, and other investors could design appropriate policies and programs that enable poor countries to harness basic ICTs for development in their own contexts (Morales-Gomez and Melesse, 1998). Given the right atmosphere, the re-enforcing positive feedbacks would then keep feeding on itself.

While E-Commerce and other technologically-enabled ways of life are great, Sub-Saharan Africa has more basic needs and capabilities at this point in its development (for the most part). Once the basic seeds are in place, we expect that the region will progress at a sustainable pace that would result in the much needed growth for the region. Not only does our new model capture the importance of actual availability of technology, it ties it to socio-economic development.

NEED FOR VALIDATION OF THE PROPOSED MODEL

As in most new models, empirical tests would be needed to validate the model proposed in this paper. For this we intend to conduct a survey instrument across some Sub-Saharan Africa countries to test the key variables in the model. We plan to use Structural Equation Modelling statistical approach to empirically examine and validate the model. In constructing the instrument, we will give preference to previously tested questions and follow generally accepted guidelines for building survey instruments (Gefen et al., 2003; Wixom and Watson, 2001).

RECOMMENDATIONS

From the revised TAM model for Sub-Saharan Africa, coupled with the fact that the region lags far behind when it comes to technology and socio-economic development, our belief is that the region is best served by a strategy of incremental development. We do not believe that meaningful and sustainable developments would be realized by flooding the continent with even the best and latest technologies. Sudden exposure to technology does not guarantee meaningful usage or concomitant acquisition of knowledge. It should be noted that the vast majority of Africa's population is still grappling with the day-to-day problems of poverty, joblessness, and various diseases of immense proportions, as well as inadequate/poor education. Our recommendations are supported by lessons learned from research in other parts of the world (Odedra-Straub, 1996; Madon, 2000; Sahay and Avgerou, 2002; Sein and Harindranath, 2004).

Furthermore, it has been shown that exposure to information sources such as the Internet tends to be correlated to income and socio-economic status. Therefore, Africa is less likely to realize the potential benefits of modern technologies due to its predominantly low income groups and the certain unequal utilization of such technologies (Oyelaran-Oyeyinka and Adeya 2002). A programmed strategy of technology and socio-economic development would work better.

Therefore, we propose that a more reasonable starting point would be to harness ICTs in areas such as the improvement of basic health, education, steady electricity and water supply, telecommunications networks, governance, the alleviation of hunger, poverty, and the conservation of the physical environment, etc.

Pursuing these key areas would enhance human development across the region, and also allow for the culturation of technology in the local and cultural contexts.

While much of Sub-Saharan Africa remains a technological desert, there is evidence that technology is making some inroads in some urban areas. There are some successes made possible by the use of technology across the region already. These are in their infancies, and we call for a strategy of steady deployment or acquisition of technology for the region to avoid what has become all too common when technologies are dumped in a region that has not had the time to develop the requisite acclamation to modern technology.

In order for the masses to benefit from the potentials of modern information technologies in the delivery of education and other needs, basic infrastructures such as school buildings and steady electricity supply that support such technologies must be put in place. ICTs that reach out to rural areas could then be implemented to support education and other needs such as healthcare, agriculture, and manufacturing. There are some efforts in the region to implement tele-education in some large cities already; these could be copied to a broader scope when the requisite accessibility and exposure to technologies are gained by the populace (World Bank / SAIDE, 1999; Nasri, 2002).

With the proper strategy, the world's technological desert could become an oasis of technological use, development, and production before too long. Not too long ago, countries such as India, Malaysia, Singapore, and Mexico were little known in terms of technology. Today, these countries are generating billions of dollars by winning lucrative systems design, coding, and production contracts from the most industrialized parts of the world to a point that some U.S. manufacturers are reeling from the resulting loss of jobs.

While the average person with entrepreneurial spirit in Sub-Saharan Africa does not have to means to embark on major they are capitalizing on the recent proliferation of cellular phones in the region. These entrepreneurs have opened up small business centers (cyber cafés, kiosks, etc.) where people could send and receive e-mails, recharge and purchase cellular phones, and chat about their new-found abilities to communicate (Meso, et al., 2004).

Another example of how technologies are being used in the local social and cultural context in Sub-Saharan Africa is the bourgeoning movie-making industry in Nigeria. Started just a few years ago, production quality has steadily improved, while keeping content in line with local values. The numbers of movies produced each month is alarming. We have observed that the industry does not rely on movie theatres, rather they retail newly released movies on DVDs and VHS tapes as a way of reaching millions of potential customers who would otherwise never get to go to a theatre. These entrepreneurs are using technology to generate income and contributing to the local economy.

We believe that one of the fears that African leaders tend to have with regards to openness or transparency is that of loss of control. However, e-government (the use of information technologies for the delivery of government services and the execution of governance mechanism within a given country) could enhance the relations of government with its citizens and legal entities (businesses, trade-organizations, institutions, not-for profit organizations, etc.), other nations, and the relationships among the various institutions of governance within a country (Thomas, et al. 2005).

Given the history of poor governance in most of the sub-Saharan African countries, E-government applications may provide a feasible and affordable platform for the enhancement of governance in these countries. Deployed with the right coordination by independent world organizations (such as UNDP, WHO, ITU, etc.), donor organizations, and private investors, Sub-Saharan African leaders could be convinced to adopt computer-based information systems and the more recent distributed web-based enterprise information systems to leverage and improve not only governance, but the quality of customer services and customer relations in corporate entities. The same applies to governmental entities where these systems can optimize the effective delivery of government services to the individuals and organizations that transact business with the given governments' various departments and agencies.

We believe that providing the populace with these and other basic needs, starting with the infrastructures that target basic healthcare and education would allow them to move to higher levels in their hierarchy of needs. It is when one has basic health and education, access to potable drinking water, roads, electricity, television, telephone, etc., that his or her horizon could extend to other matters such acquiring and applying more modern technologies to their full potential. We feel that sustainable development will continue to

elude Africa until the factors (mentioned above) that curtail improvements in socio-economic, human, and technology development are addressed in a programmed manner. Until this is achieved, the conventional Technology Acceptance Model would be of limited applicability in studying IT adoption in Sub-Saharan Africa. It is in light of this that we offer what we believe is a more appropriate model.

CONCLUDING REMARKS

The contribution of this study has been to enhance our understanding of the interactions that come to bear between socio-economic and human development needs and factors generally innate to Sub-Saharan Africa and other less developed regions that manifest to impede technological accessibility, exposure and therefore adoption. We have argued that Sub-Saharan Africa has some factors that do not show up in the conventional Technology Acceptance Model, whose premise was based on settings that are essentially applicable to industrialized nations. By extending the influence of the perceived user resource model, which in turn was developed from the original TAM literature (Davis, et al., 1989; Mathieson, et al., 2001), and borrowing from ideas espoused in socio-economic development literature, we developed an extended model that accounts for technology availability. This new model enhances our understanding of technology adoption that captures the context of Sub-Saharan Africa and other developing regions of the world. We believe that the new TAM model presented here would be more relevant to less developed regions such as Sub-Saharan Africa where universal access to ICTs and sustainable economic development remain illusive.

Follow-up studies as proposed in this paper would shed more light on the validity of the new model. We have attempted to show the links between socio-economic development and technology adoption. On a global scale, it could be argued that these findings may be applicable to certain situation in developed countries such as the U.S. and others, where a digital divide exists along income and education levels, as well as along race, age and other variables (Moreles-Gomez and Melesse, 1998).

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Paradigms of ICT in Development

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Abstract

While the role of ICT in development is generally agreed to be important, the actual process through which ICT influences development is not clear. A growing body of literature has delved into conceptual and theoretical aspects of ICT in development in order to understand this process. The contextual nature of ICT and the situated organizational analysis of such interventions are examples of this stream. However, the ideologies and logic behind the behaviour of the actors have received less attention. In this paper, I argue that ICT is not neutral and that the paradigmatic premises of the ICT intervention affect the outcome. This has implications for specific aspects of development initiatives such as IT education and thus development of human resources. Borrowing from the IS literature, I distinguish between four different paradigms of ICT in development: functionalism, social relativism, radical structuralism and neo-humanism. I discuss the implications these paradigms have on the manner in which the ICT intervention plays out in a developmental context.

INTRODUCTION

Is ICT an appropriate and useful tool for development? While the answer is debated amongst practitioners and scholars of development, it is generally accepted that ICT is here to stay and do have an important role to play. There are numerous articles that argue that ICT has led directly to development (e.g. any report by an international agency such as IT or World Bank) giving rise to the optimistic perspective of ICT-in-development. There are as likely large number of articles that argue the opposite and espouse the pessimistic view that not only there are no effects of ICT on development, but it has actually harmed the cause.

Delving into the debate is beyond the scope of this paper. Such analyses exist elsewhere (e.g., Sein and Harindranath, 2004, Heeks, 2002, Avgerou, 1998, Madon, 1997). For now, I will accept the reasonable conclusion that ICT **can** be a catalyst for development provided they are deployed in context, viewed as an enabler of knowledge and as an ensemble of social, human and technology elements, and applied to specific aspects of development, e.g., education and human resources, health etc. The impact should also be studied in terms of a tertiary effect (Sein and Harindranath, 2004), i.e., the extent to which it has resulted in creating new social structures and fostered innovations around ICT.

Whether we can detect the impact of ICT on development is another issue. As Sein and Harindranath (2004) concluded, direct links may not be found because ICT changes the dynamics of development and there are unintended consequences of ICT. Moreover, as Nustad (2001) opined, how a specific development intervention plays out in the field is unpredictable.

What we can do under the circumstances is to examine the nature of ICT interventions closely to make some sense of these conflicting results. In this paper, I borrow a perspective of Information systems (IS) development paradigms (Hirschheim and Klein, 1989) to analyze ICT interventions in developing countries. According to the authors, IS development is not neutral but the design and the process of developing systems is biased by fundamental assumptions of the system developer, i.e., their views about reality (ontology) and the way of knowing the reality (epistemology). This affects the nature of developed systems and the resulting changes in organisational practices (in the organization where the system is implemented). Following this argument, I posit that ICT in development is governed or at least heavily influenced by the way the various actors involved conceptualize the nature of their role and their mission and thus influence how the intervention plays out.

The analysis in this paper is also informed by the institutional view of ICT in the development context (Avgerou, 2003). In her insightful examination of ICT as an institutional actor, she stresses the need to go

beyond situated analysis of ICT intervention and consider history and past experience. I attempt to do so here by examining the paradigmatic assumptions behind these interventions.
The rest of the paper is organized as follows. The next section presents the IS development paradigms. In the section following, I map these paradigms into ICT interventions in developing countries. I conclude the paper by discussing implications delving specifically into IT education and human resources development.

PARADIGMS OF IS DEVELOPMENT

Hirschheim and Klein (1989) used Burrell and Morgan's (1979) conceptualization to propose that IS development can be broadly classified into 4 paradigms (see Figure 1).

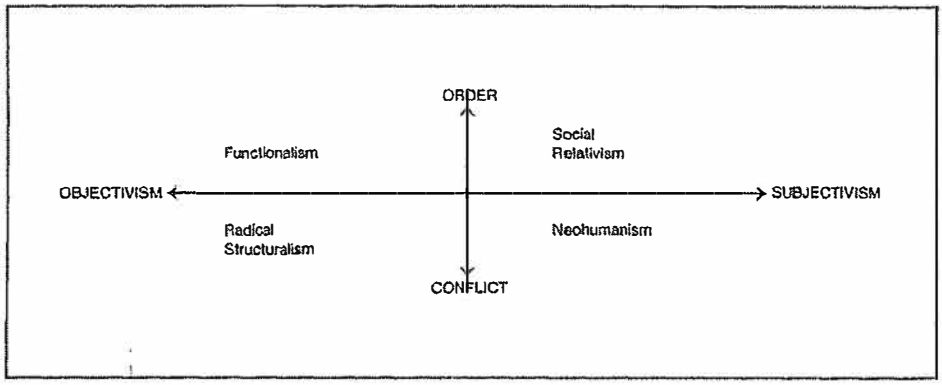

Figure 1: Information Systems Development Paradigms (From Hirschheim and Klein, 1989)

The paradigms resulted from two axes. The Objectivism-Subjectivism axis represents the epistemological perspectives of the IS developer. The objectivist views the world through the lens of natural sciences and seeks to apply models and methods borrowed from natural science disciplines to study the organization. The subjectivist, by contrast, studies human life through the experience of the individuals concerned. The context becomes the key not only in terms of the situation but also the individual. The Order-Conflict axis represents the ontological perspective. One can view the world as orderly, stable and functional coordinated. In contrast to this "integrationist" view, the conflict end views the world as in constant state of conflict, stress, coercion and change. A combination of these dimensions gives rise to the four paradigms: Functionalism, Social relativism, radical-structuralism and neo-humanism.

Hirschheim and Klein (1989) map IS development into these four paradigms and demonstrate that they result in very different artifacts and more importantly sharply contrasting development processes. Table 1 summarizes the features of the different paradigms. While that in itself informs us about the context of ICT interventions in development initiatives, more germane is the conceptualization of the role of the IS developer under these paradigms.

Paradigm	Developer archetype	Systems development process	Elements used in defining IS	Examples
Functionalism	Expert or Platonic Philosopher King	From without, by application of formal concepts through planned intervention with rationalistic tools and methods	People, hardware, software, rules (organizational procedures) as physical or formal, objective entities	Structured analysis, information engineering
Social Relativism	Catalyst or Facilitator	From within, by improving subjective understanding and cultural sensitivity through adapting to internal forces of evolutionary social change	Subjectivity of meanings, symbolic structures affecting evolution of sense-making and sharing of meanings, metaphors	Ethnographic approaches, FLORENCE project
Radical Structuralism	Warrior for Social Progress or Partisan	From without, by raising ideological consciousness through organized political action and adaptation of tools and methods to different social class interests	People, hardware, software, rules (organizational procedures) as physical or formal, objective entities put in the service of economic class interests	Trade-union led approaches, UTOPIA and DEMOS projects
Neohumanism	Emancipator or Social Therapist	From within, by improving human understanding and the rationality of human action through emancipation of suppressed interests and liberation from unwarranted natural and social constraints	People, hardware, software, rules (organizational procedures) as physical or formal objective entities for the TKI; subjectivity of meanings and intersubjectivity of language use in other knowledge interests	Critical social theory, SAMPO project

Table 1. Summary of the Four Paradigms (From Hirschheim and Klein, 1989)

Under the functionalist paradigm, the systems developer takes the role of the systems expert who has the task of discovering the objectives – or is often given pre-determined objectives – which s/he embodies in the produced system. The objectives are given by the management and the developer uses the context-free technical knowledge to develop the system. The user groups (lower end employees) are then trained, or in some other manner persuaded to use the implemented system. Essentially, the developer is a neutral actor. In the social relativist paradigm, the systems developer is a facilitator who helps the user groups discover the objectives of the system and the technology applied is specific to the context. The interests of the user groups are paramount even at the expense of management objectives although both can have the same objectives. By contrast, the systems developer under the radical structuralist paradigm is an activist whose aim is to represent the users mainly lower end employees against the exploitative aims of the management. This conflict between management and employees is inherent in this paradigm. Hence the developer takes the side of the employees in contrast to representing the management. Finally, in the neo-humanist paradigm, the developer is an emancipator who, in developing the system, produces an artifact that improves understanding between groups and frees the various actors from biases and constraints.

I argue that these paradigms apply to the context of ICT interventions in development. To demonstrate this postulation, some analogies need to be drawn. The prototypical development context, especially in terms of ICT today is that these interventions are funded by donor agencies and carried out through either foreign personnel or in conjunction with some non-governmental organizations (NGOs). So, it is reasonable to argue that the role of the "foreign personnel" is analogous to the systems developer, the donor agencies are analogous to management and government in some cases and the users are the same in both contexts

ICT-IN-DEVELOPMENT PARADIGMS AND ROLES

Before proceeding to the mapping of roles, it is worth examining the axes of Burrell and Morgan's dimensions in the context of ICT in development. The epistemological dimension represents the lens through which the interventionist sees ICT. At the "Objectivist" end, ICT is seen as neutral and applicable in a context-free manner. Thus ICT is viewed as a "tool" or a means to support an activity (See Sein and Harindranath, 2004, for a discussion on the views, uses and impact of ICT in the development context). At the "Subjectivist" end, ICT is viewed as more than a tool and its exact meaning depends on the context it is used (See Walsham and Madon, 1995 for an illustrative case). ICT use is thus situated (Suchman 1987). This is the "ensemble" view of ICT (Orlikowski and Iacono, 2001). The ontological axis represents how the world in the context of development is understood. At the "Order" end, the world is stable and orderly

and functional – in other words, it represents the developed world. Thus the aim of development is to move the underdeveloped world towards this desired state of being like the developed world. This is precisely the modernization perspective of development. At the "Conflict" end, the world is understood to be in constant state of flux and conflict. Development then cannot be seen as aiming to reach any state – since every state is unstable. Rather, development has to be seen in context and each underdeveloped country takes its own unique trajectory towards development. Thus development is seen from a non-modernization perspective and takes on these views: dependency, Marxist and human development. Collectively, we term them as the "alternative" view of development (Black, 2002).
Thus, the four paradigms of ICT-in-Development take the following combination.

- Functionalism: modernization perspective of development and neutral view of ICT,
- Social relativism: modernization perspective of development and situated view of ICT
- Radical structuralism: alternative perspective of development and neutral view of ICT
- Neo-humanism: alternative perspective of development and situated view of ICT

These paradigms are discussed in details below.

Functionalism

The main actors in this paradigm are the Foreign Expert who works for or on behalf of a donor agency. The government of the host country has a relatively passive role The foreign expert's job is to deploy ICT in furthering the objective of attaining "modernization" that is transfer technology as implemented in the developed world to the underdeveloped world. The foreign expert serves the objectives of the donor agencies that may or may not coincide entirely with the objectives of the government.

There is a certain amount of adaptation but as Avgerou (2003) points out the adaptation is more in line with "localization" such as adapting to local laws and language (at times). So local context is not deemed to be vital. ICT is essentially a tool that supports modern management practices. Often there is transfer of technology or practices between underdeveloped countries. A good example is the use of "best practices" by donor agencies such as World Bank (Courtright, 2004). Capacity building projects, infrastructure building and whole scale "computerization" projects aimed at reducing the digital divide undertaken under the auspices of such donor agencies as OECD, ITU etc. fall into this paradigm (see for example, OECD)

This is arguably the most common paradigm in ICT interventions. It is an offshoot or even an integral part of the predominant paradigm of donor-led assistance programs that takes the modernization perspective of development (see Black (2002) for a critique of this approach) It frees the "expert" from the contextual perspectives and enables him/her to concentrate on what he/she knows best – implement a system in an almost mechanical manner. The higher level objectives are moot. This of course leaves it wide open to the criticism that the focus is on the means – i.e., the ICT – rather than the ends – i.e., development.
There are other dangers. Since ICT is deployed in a context-free manner, ICT is not neutral and thus can become a mechanism of control. This is especially so since the effects of ICT is measured more in terms of the primary effect (substitution of the old with the new – e.g., using cell phones instead of fixed line phones) or even secondary effect (increase in the phenomenon enabled by the ICT - e.g.,, more communication between people) but not tertiary (structural change – e.g., what does this increased communication means to people's lives). This means that existing social order prevails and if the context is restrictive, use of ICT increases the restrictiveness. A more cynical danger exists. There is little discussion on the appropriateness of objectives of the interventions. In the worst case, this paradigm may be looked at increasing the dependency of the underdeveloped countries on the donor countries.
The arguments of the "dystopian" view of ICT in development follow from this paradigm (Soeftestad and Sein, 2003, Morales-Gomez and Melesse, 1998).

Social Relativism

The main actors in this paradigm are the foreign personnel and an agent or representative of the local population. Unlike the foreign "expert" of the functionalist paradigm, he/she is the "foreign consultant" taking the role of the facilitator. Local context is vital in this paradigm since, like the case with IS development, the ICT intervention is mostly from within the context. Hence there is a need for local

participation. Often but not always, the local representative is some local NGO. The mission is still to move the host country towards the path of modernization. But the crucial difference with the functionalist paradigm is that ICT use is situated – the same methods, systems and processes that have been successfully applied elsewhere may not be successful in another context. ICT is thus an ensemble, comprising not only of the technology, but also the people who use it or are affected directly or indirectly by it, the social system surrounding the people and the system, and the environment. Historical context plays a vital role.

It is inherently accepted that the deployment of the ICT, and the very process of the intervention, creates new meanings. Thus the unintended consequences of ICT and its interaction with the dynamics of the field can result in an outcome that no one had thought of at the outset.

Yet, the development perspective remains modernisation. This paradigm can be characterised as "modernization with a human touch". Contextualized best practice is a good example of ICT initiatives. The vast majority of the "reformed" aid programs fall under this category. For example, cultural diversity has taken a key role in the aid lexicon. The 2004 UNDP report on human development has cultural diversity as the theme (UNDP2004a). Programs funded by Nordic governments provide another set of examples. To take just one example, the Norwegian government, through its aid agency NORAD has been funding ICT infrastructure development in some institutions of higher learning in Tanzania. NORAD itself is not involved in the activities; rather the actual work is carried out by academics from a Norwegian university college "the foreign consultants". The Tanzanian counterparts are also mainly academics and administrators from the Tanzanian university. The projects are termed as "collaboration" and not "donation". Every effort is made to stay within the frame of the Tanzanian context. Yet, the goals are mainly in keeping with modernization and evaluation of the various projects is done with management principles and concepts from the western world. The result has been rather mixed. While there has been much improvement in the infrastructure, the organizational processes have not been affected in the same manner (For a good analysis, see Orvik and Furuholt, 2003).

There are other dangers with this paradigm. One is analogous to the debate surrounding the notion of appropriate technology (Soeftestad and Sein, 2003) which also places contextuality above all. Thus, as Hirschheim and Klein (1989: 1206) point out. "Because of its relativist stance, it is completely uncritical of the potential dysfunctional side effects of using particular tools and techniques for ISD". This paradigm is also vulnerable to subtle implants of ideological meaning

Radical Structuralism

Unlike the previous two paradigms, this paradigm and the next one move away from the modernization perspective of development The main actor is the ICT interventionist who is often a foreign activist but may be someone from the local context (although the latter is more likely to be in the Neo-humanist paradigm). This paradigm views the world as in conflict and thus of one group dominating and aiming to maintain this dominance over another group. Often the dominating group is the developed world which by practice or design maintains its dominance over the developing world. Thus, the development perspective is "dependency" – where developed countries became rich by exploiting the poorer countries through colonialism in the past and unfair trade practices currently - or "Marxist" where there is a similar conflict between the classes – external (between countries) or internal (repressive governments and citizenry). ICT is either a tool or proxy/enabler (representing entrenched power or an enabler of "people's voice"). The context is a relatively non-issue since conflict is seen as endemic and prevalent across cultures and nations.

This paradigm is best understood when we look at the debate on call centre outsourcing, specially the case of India (see for example Mohaiemen in AfterNet). It has variously been hailed as a great success story or exploitation. The media has focussed almost entirely on the success element (e.g., the US televisions network CBS's story in its highly rated program "60 minutes"). It was credited with creating jobs – "highly skilled" jobs, according to media reports – and increasing the wellbeing of Indian IT workers who earn more than their counterparts in other IT-related jobs in India. It became a controversial issue only when it was blamed for loss of jobs in US (another news organization, CNN, did a "town meeting" discussion on the topic from India).

Others see it in very different light. They term it as "the new slavery" where Indian IT workers serve the needs of foreign bosses with little benefit to India. Critics concede that there are the obvious benefits of creating jobs and increased incomes for those employed in this industry. However they decry the "humiliating" aspect of having to hide their true identity and play out the charade of being from the same country as the customers of the employers (for example Indians take on Anglo names and to serve their American employers, learn to speak with an American accent).

In that call centres serve the needs of the developed world, and the benefit accrued is vastly in favour of the developed world, this is a good illustration of the dependency perspective. The benefits to developed countries are directly through the characteristics of ICT while the benefits to the call centre hosts are not primarily ICT-related – the technology is only a commodity. The experience and knowledge and skills gained by working as a call centre operator do not necessarily transfer into meaningful use of ICT for development of India itself. Nor does the benefit accrue to the poor (call centre workers appearing on the CNN discussion show talked about what they were able to buy – "same as in America", as one employee put it). The benefit of outsourcing itself is transitory when it comes to a specific country. Since it is driven mainly by the cheaper labour costs in developing countries, the model is premised upon a continued existence of poor countries.

The main actor in this paradigm then is the voice that becomes a partisan for the "exploited" class, such as the call centre employees. Academics and NGOs represent this voice. Yet, this paradigm ignores the possibilities of such initiatives. For example, call centre operators have the potential to be drivers for innovation of new processes. The belief in constant conflict also deters from achieving a search for a win-win situation.

Neo-humanism

This is in many ways, the "ideal" paradigm. The development perspective is alternative specifically human development (see Nederven Pieterse (2001) for a detailed discussion on this and Sein and Harindranath (2004) for an introductory treatment). The process is emergent. The interventionist is an emancipator whose aim is to help the citizens of a developing country discover for themselves the objectives of development. The exact application of the technology is highly situated and contextual. ICT is seen as an enabler of this process. Its role is to allow the debate and discourse related to development. The main actors are from within a developing country often with help from foreign experts who view themselves as emancipators. A typical manifestation of this paradigm is the keynote speech delivered by the late Kristen Nygaard at the 2002 workshop of IFIP W.G. 9.4 at Bangalore as reported by Krishna and Madon (2003) "Prof. Kristen Nygaard, Oslo University, delivered the keynote speech on 'ICT and Development: A Question of Perspective'. Development, he observed, depends on one's choice of perspective. He emphasized the need for involvement of the community in development initiatives. People must develop in such a way that they themselves understand the way they want to develop. It's their lives and their decisions, and if they are wrong they need to find it out themselves. There is no substitute for this process, he said"

Just as Hirschheim and Klein (1989) did not find specific examples of this paradigm of IS development, it is also not overtly apparent in ICT in development. However, it is embodied in many projects and policy documents of several agencies. For example, the 2001 human development report of UNDP concludes that the role of ICT may well be to help the developing countries set their own strategic agenda (UNDP 2001). Other examples are e-Government initiatives (UNDP, 2004b) and goals expressed in OECD declarations. More concrete examples are distance learning projects, knowledge networks (see Cummings, Heeks and Huysman) and e-Democracy (see Korac-Kakabadse and Korac-Kakabadse, 1999). The call for locally developed software by local personnel for local needs is also an example of development in this paradigm (see Soriyan, Korpela and Mursu, 2002).

As appealing as this paradigm is, there are also challenges before it can be achieved. Problems such as illiteracy, weak infrastructure and the very need for openness create a chicken and egg situation. ICT is needed to enable these capacities, but the successful deployment of ICT also depends on solid foundations in these areas.

DISCUSSION

While operationalisation of these paradigms is not unproblematic, they show the range of ideologies that lie behind ICT projects in developing countries. They can serve as a useful lens to examine the implications for initiatives in specific areas of development. Before proceeding to the theoretical implications of the paper, I offer some implications for human resources development seen from the perspective of ICT education.

Implications for ICT Education and Human Resource Development

Each paradigm produces priorities for developing skills in ICT in keeping with the premises of the paradigm. Functionalism does not emphasize context and views ICT as neutral. ICT education therefore stresses the development of skills that Quinn, Anderson and Finkelstein (1996) term as "cognitive skills (know what) and advanced skills (know how)" (p. 8). The objective is to produce personnel skilled in general ICT concepts and tools. While this is essential, especially for "basic computerization", it is not sufficient. Such education can serve the outsourcing industry which leads to the debate on the true benefits of outsourcing. The social relativist paradigm stresses context and so skill development is built upon context-specific ICT education. While a modernization perspective of development means a "western oriented" curriculum, and may stress best practices, the application to the local context is emphasized. In terms of Quinn et al. the objective is to develop system understanding skills (know why). The same emphasis also characterizes the radical structuralism paradigm that also stresses context-specific ICT education. In addition, it also requires awareness of the socio-political perspectives and on local initiatives. ICT education by itself is not enough, an equal emphasis need to be placed on the country's history, society and political discourse. Finally, the neo-humanist paradigm stresses the contextual elements (in addition to ICT education) but also requires skills in generating innovative ideas and even theorize about ICT's role on development. This type of skill is termed "motivated creativity (care why)" (p: 8) by Quinn et al. (1996).

The paradigmatic influences on human resource development outlined above are magnified in today's global society. Many developing countries have reported a drastic decline in enrollment in ICT programs (One university in Bangladesh saw the number of applicants in their Computer Science program drop from 120 to 13!). The decline is linked to the lean times being experienced by the IT industry in the developed world and thus a decline in outsourcing projects. That the developing world itself needs skilled ICT personnel does not seem to influence this trend. One can argue that developing countries do not have the capacity to absorb a large number of skilled ICT personnel. However, this drives home the point that we may not have escaped a functionalist view of ICT education and that the innovativeness and creativity that can come from following the premises of the other paradigms is yet to be achieved.

Theoretical Implications

Admittedly, the paradigms are not as parsimonious as one may be led to believe by the arguments in this paper. There are overlaps and not all, or even the majority of the ICT interventions, can be neatly slotted into one or the other of the paradigms. Multiple paradigmatic underpinnings are not only possible, but may be desirable as well. I agree with Hirschheim and Klein (1989) that such multiple paradigms may lead to creative solutions. Consider the call center example. Strictly viewing it from the radical structuralist perspective only unearths conflicts. One result that we can already observe is the call for shutting down such centers. (This may be a political issue and the rhetoric may well have magnified due to the 2004 US presidential election). Viewing this from the neo-humanist paradigm, one can see it as an opportunity to turn the dependency table around – make the developed world dependent on the developing world. (The ICT equivalent of what the author Salman Rushdie once described as "the empire writes back" in discussing the eminence that Commonwealth-born writers have attained in English literature and the Nobel Prizes won by amongst others Wole Soyinka, Chinua Achebe and V.S. Naipaul). There is also the potential for developing indigenous ICT industry aimed towards achieving national goals.

The views expressed here need to be critically examined. For example, my contention that the functionalist paradigm is the predominant one is a conjecture based on extrapolation from the general development

literature. Empirical validation of this is needed. The roles of the actors in development is also somewhat simplified. While I delve into the roles of the "interventionist", the role of the government was mentioned only in passing. It is intriguing to examine which paradigm dominates government thinking. For example, are governments functionalists?

ICT-in-development is a complex and vastly heterogeneous area. A deeper examination of conceptual aspects can only add to the growing body of literature that is answering calls for theorizing in the field (Avgerou and Walsham, 2000; Sahay and Walsham, 1995). Avgerou (2003) bemoans the fact that there are few studies in the literature that link "international institutional processes of IT innovations in specific organizational settings with macro-level analysis of ideology, normativity, coercion and large scale power dynamics. The situated organizational analyses of IS do not usually trace the logic of the actors' behaviour to their lives beyond the organizational boundaries and do not consider the way the route of an innovation process is imagined, legitimated, or enforced by extra-organizational forces" (p. 50).

In this paper, I have made an initial attempt to link some of these "missing" elements into the analyses of ICT interventions in development initiatives. By specifically addressing the ideology and the perspectives on the normativity of the actors involved, I raise these questions:

- Are we aware of the paradigmatic premises to which the ICT interventionist subscribes?
- How does this ideology manifest itself in the role that the actors take?
- What are the consequencies of taking this role?

In combination with this awareness, comes the opportunity of self-reflection. Do we knowingly take this role?

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SESSION A4: RESEARCH PAPERS: IT & HR DEVELOPMENT IN EDUCATION AND LEARNING

Systems for the Production of Plagiarists: Developing countries and use of plagiarism detection systems in UK universities

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ABSTRACT

This paper argues that the inappropriate framing and implementation of plagiarism detection systems in UK universities can unwittingly construct students from developing countries as 'plagiarists'. It argues that these systems are often implemented with inappropriate assumptions about plagiarism and the way in which new members of a community of practice develop the skills to become full members of that community. Drawing on the literature and some primary data it shows how expectations, norms and practices become translated and negotiated in such a way that legitimate attempts to conform with the expectations of the community of practice often become identified as plagiarism and illegitimate attempts at cheating often become obscured from view. It argues that this inappropriate framing and implementation of plagiarism detection systems may make academic integrity more illusive rather than less. It argues that in its current framing—as systems for 'detection and discipline'—plagiarism detection systems may become a new micro-politics of power with devastating consequences for those excluded.

1. INTRODUCTION

The theme of this IFIP 9.4 conference is "Enhancing Human Resource Development through ICT". In this paper we want to suggest that ICT—in the form of plagiarism detection systems—may in fact being framed and enacted in the UK higher education sector to achieve exactly the opposite. We want to argue and show that they configure many of the international students—mostly from developing countries—inappropriately as plagiarists. We want to question the assumptions with which these systems are framed and implemented and problematize the notion of plagiarism with regard to international students. We want to suggest that these detection systems and the values and practices that they assume do not 'translate' to the pedagogical reality of many of the students from developing countries.

The issue of plagiarism within higher education has received considerable attention in the literature over recent years (Harris, 2001; Carroll & Appleton, 2001; Lathrop, 2000; Dryden, 1999; Myers, 1998; Pennycook, 1996; Scollon, 1995; Howard, 1995, 1993; Deckert, 1993; Sherman, 1992; Kolich, 1983). The Oxford English Dictionary defines 'to plagiarise' as "to take and use another persons ideas, writing, or inventions as their own." In academia this typically involves students taking the words of others and passing them off as their own in their coursework assessments. In this paper, we do not set out to redefine plagiarism, instead, we wish to provide a more in-depth understanding of why some international students may be predisposed to plagiarise, and how *plagiarism should not be synonymous with cheating* (Hunt, 2003). Furthermore, much of this literature on plagiarism, coupled with the considerable anecdotal evidence amongst colleagues within our own and other universities, suggests that plagiarism is on the increase.[i] In relation to the literature that has considered why students plagiarise, Carroll (2002) has suggested that most students are unsure what plagiarism is. She argues that this lack of understanding of what is and what is not plagiarism contributes to students plagiarising unintentionally. Furthermore, Angelil-Carter (2000) claim that there is also a lack of clarity across a university about what constitutes plagiarism and a discrepancy in the way plagiarism is detected and enforced (Biggs, 1994; Ryan, 2000; Scollon, 1995). Carroll (2002) also argues that the move from examination to coursework and project based assessment has resulted in not just over assessment, but students experiencing continual pressure to attain high marks (Carroll, 2002). Others suggest that poor time management by students, or the institutions setting simultaneous deadlines is a major contributing factor (Errey, 2002). Though all of these issues are relevant to students in developing countries, very little literature has focussed specifically on the theme of this paper, namely why students from developing countries may be discovered as borrowing the words of

others when studying in developed countries such as the UK. No literature to date has considered what issues this raises for the introduction and use of electronic detection systems, the focus of this paper.

1.1 On Borrowing Words

Several commentators have noted that already published material is utilised as a resource for students to imitate its vocabulary, structure and ideas (Shi, 2004; Leki & Carson, 1997). This is seen as being particularly the case for non-native speakers, many of whom view this as being acceptable practice. As was evident in Matalene's study (in Shi, 2004), where after the teacher had explained what plagiarism was, a Chinese student noted:

> *"we understand that in her country or some others plagiarism is forbidden... However in our country, things are a little different. We may perhaps call what our teacher calls 'plagiarism' as 'imitation,' which is sometimes encouraged, especially for a beginner."*

Thus it seems that for students in China copying the words of others is legitimate, and indeed a central part of their education. Shi's (2004) detailed study of Chinese students who's second language was English, and Canadian students who speak English as their native language, found that often Chinese students copied long strings of texts in their work, as compared to English speaking students, indicating that they have no awareness of the risks associated with plagiarising, nor do they have an awareness of how to reference. In contrast she found that English-speaking students would use citations for even short strings of borrowed words. Shi (ibid) argues that there are differences between Chinese and English-speaking students as to how many words can be "borrowed without citations." She suggests that the Chinese students "imitated and reproduced large segments of others words with no apparent intention to steal and cheat." She draws on Angelil-Carter (2000) to argue that this may be due to books being viewed in some cultures as authoritative texts, and the copying of that text being an act of respect rather than as plagiarism.

A further explanation provided in the literature for why Chinese students copy the words of others derives from the power structures between teachers and students. Turner (2000) claims that the authority of the teacher and the subservience of the student is a commonplace value in the Chinese educational context. Turner (ibid) notes that in the Chinese classroom the norm is for the teacher to speak and the students to refrain from asking any questions. Further, it is unusual for the teacher to ask students questions during the class. Turner (ibid) found that if questions are asked, they only require factual responses and not opinions or justified arguments. She further claims that students are not encouraged to take notes other than exact copies of those written on the whiteboard. Furthermore, she explains that as work is almost completely exam based, this not only means that students are assessed individually, but also that students are unlikely to have any experience in structuring and developing an argument in an essay, nor as Turner (2000) highlights:

> "will they have any experience of using references or multiple sources of information to inform their written work or their thinking.... The teaching method emphasises the correct memorisation and reproduction of teacher's notes or textbook information - referencing is not used, since almost the entire essay [in the exam] may be in the form of *memorised sections of text.* Information is viewed in a unitary way: the teaching of facts. Critical examination of different perspectives on a subject, and the development of an argument is absent within Chinese education. (Emphasis added)

As such, one central feature of the educational context within China is how the exact reproduction of the teacher's voice (or prescribed textbook) might be seen as necessary to succeed. Further, Biggs (1994) warns that this should not be viewed necessarily as an inferior approach to learning (Biggs & Watkins, 1996).

Others suggest that Chinese students may be predisposed to copying the words of others due to their different view of language. Pennycook (1996) has argued that the Chinese view of language is quite different from that in Western Countries: "In this [view of language] primacy is accorded to language and not to the 'real' world, notions such as metaphor, which suggests that some word 'stands for' something else, become quite different because reality is in the language and not in the world" (p.221). The Sinologist Hans-George Moeller (2003, p.75) also expresses this view that the author and the text are inseparable noting that:

> "Chinese theory of 'forms and names' granted an equal ontological status to both the matter *and* the designation of the things. To use a more formal expression, not only the signified but also the signifier was considered to be inherent in the things. *The signifier was not conceived of as an arbitrary 'label' or as being only attached to things a posteriori. Its name belonged to the thing just as much as its form.*

Obviously, there is an issue with regard to the degree that this ancient view of language is still evident in contemporary everyday practice. Nevertheless, to the extent that it still is, it would suggest that for Chinese students altering the exact expression of something might plausibly be seen as altering the reality of the world itself. Where would the authority to do this come from for a student? Furthermore, capturing the exact expression—through meticulous memorisation—would be seen as capturing the reality as such. Thus, students would be encouraged to express reality by using the words, the exact expression of the master—i.e. retaining the master's voice as it were.

The differing cultural norms to attributing a specific text to an author was highlighted by Moore (1997). This study found that native English speakers mentioned the author explicitly in their essays while the Asian students who had English as a second language (ESL) used attributions that were implicit such as "it was said" or the article aims to" (in Shi, 2004). Shi's (2004) study similarly found that North American students would present the author in their essay as a named individual, while the Asian students would "tuck away the author in a less central position." Moore (1997) provides an explanation of this cultural variation in attributing sources claiming that Asian students regard an original text as being information, while native speakers view a text as reflecting an individual's point of view.

Copying words verbatim, and patching them together is reported to be acceptable practice in many Asian universities. This was confirmed in Dryden's (1999) study, which quoted a Japanese professor stating that: "students are supposed to show how well they can understand several books and digest them in a report or a paper. They aren't asked for original ideas or opinions. They are simply asked to show a beautiful patchwork...as long as you mention all the books in your bibliography, you can present the ideas from the books as if they were yours, especially if your patchwork is beautiful" (p. 80). In this sense, the study by Dryden (1999) highlights how patch writing is viewed as *an active and informed engagement with a text,* rather than mere 'mindless' copying.

Similarly, Shi's (2004) study found that much of the Chinese students writing were "patch writing, interwoven with sentences or phrases copied from original sources". Shi (2004) found that Chinese students relied heavily on the source text due to their "limited language ability and lack of experience with citations," and as a consequence does not believe that they could express the words better themselves (Hayes & Introna, 2004; LoCastrol & Masuko, 2002). Shi (2004) notes that as learners, "many L2 (ESL) students consider it legitimate and natural to reproduce chunks of others' words because many of them would doubt whether they have any words of their own in a language that is not their L1 (Native students)."

Shi (2004) concluded her study by noting that for those students providing syntactically reformulated text, that this latter form of copying "demonstrates a step away from direct copying, a move perhaps necessary for these ESL (Chinese) student writers to eventually own these words, noting "the frequent replication of words from the preassigned source texts might imply an effort of these L2 students in a context of

learning." Crucially, Shi (2004) suggests that for many overseas students copying and integrating the words of others is central to their development as academic learners, noting that by insisting firmly on no copying of texts "we actually deprive them of the strategy or natural resource that many L2 students rely on. Shi (2004) suggests that universities in western countries need to relax the requirements for overseas students, noting "we need to distinguish legitimate appropriation of language from dishonest copying so as to make ways for novice L2 writers to traverse the boundary and become members of the academic community." Indeed, others have suggested more strongly, that copying is a central and expected part of the development of students whose first language is not English (Hayes & Introna, 2003; Bloch & Chi, 1995; Campbell, 1990). The inappropriate use of sources is also attributed to students whose first language is not English, not having the proficiency or experience in referencing.

1.2 On Detecting Copies

Before going on to outline the focus and the structure of this paper, we will first briefly describe how electronic detection software operates. It is important to recognise that Plagiarism Detection Software detects *copies* not plagiarism. There are a number of proprietary brands that have emerged in recent years, most notably *Turnitin* and *EVE*, each of which have their own propriety algorithms for detecting plagiarism. In general, plagiarism detection systems make a digital fingerprint of a document that it then uses to compare documents against each other. The fingerprint is a small and compact representation of the content of the document that can serve as a basis for determining correspondence between two documents (or parts of it).[ii] These fingerprints are said to be extremely accurate in detecting copies even though it is estimated they may be only 0.536% of the original document size.[iii] These fingerprints are then compared with web pages, previous documents submitted to the specific plagiarism detection Software Company, and increasingly electronic libraries. It is clear from various experiments with Turnitin that plagiarism detection algorithms are reasonably robust at linking copies (not plagiarism) or part copies back to its source document (Introna & Hayes, 2004).

This paper will consider how and why Chinese and Asian students *plagiarise*, and specifically the issues this raises for electronic detection. To do this, the paper is structured as follows. The next section will describe our methodology. Section three will summarise the findings from an earlier empirical study conducted by the authors. The followings section will consider the implications for employing electronic detection systems such as Turnitin for students from developing countries. Section 5 will offer some brief conclusions.

2. METHODOLOGY

Our empirical research was conducted with a cohort of MSc students studying an MSc in Information Technology, Management and Organisational Change (ITMOC), at Lancaster University Management School. We sought to understand the students past practice and judgements on various manifestations of academic malpractice in their home universities. There were 46 students in that year's cohort with a diverse range of nationalities, including students from India, Pakistan, China, Indonesia, Thailand, Greece, and a selection of others from Europe, the Pacific, the Caribbean, Africa and South America.

We conducted focus group interviews and distributed questionnaires. Supplementing this was considerable informal discussion with ITMOC students. The authors are past and present programme directors. This led to an exceptionally high response rate from the questionnaires, as well as a high attendance at the focus groups. The focus group interviews lasted approximately 45-60 minutes each, and were organised on the basis of national/ regional origin. They were tape-recorded and the notes were later transcribed. This resulted in five groupings, a Chinese group, an Asian (other) group, a Greek group, a UK Group and a group from the rest of the world. The explanation for the Asian (other) grouping was due to there being insufficient numbers of students from individual Asian countries to warrant a category themselves. This group comprised of one Thai, one Pakistani, one Indonesian and two Indian students. The Chinese group comprised of seven students. As with the questionnaires, our focus group discussion sought to understand the students' experiences prior to coming to Lancaster, though the conversation inevitably became referential to their experiences of plagiarism since arriving in the UK. As this paper explores the cultural

understandings of plagiarism for students from non-western countries, and the use of plagiarism detection systems in UK universities, we will solely report on the Chinese and other Asian students.

3. STUDENT'S ATTITUDES TOWARDS ACADEMIC INTEGRITY IN COURSEWORK

This section will introduce the issues that emerged in the focus groups and questionnaires.

		Asian	Chinese
Action	**Once or more**	20%	40%
	Never	80%	60%
Judgement	**Not or trivial cheating**	40%	30%
	Somewhat or very serious	60%	70%

Table 1: Copying material, almost word for word, from any source and turning it in as your own work

The first surprise that faced us when initiating our empirical work was to find that both the Chinese and other Asian (referred to just as Asian) students explained that they had little experience of coursework during their undergraduate education and thus were not able to comment extensively on the issue of plagiarism in coursework. In China, it was estimated that they only write one essay during their entire undergraduate education—though Chinese students did note that they wrote a number many reports. They claimed that though they were required to reference in their coursework, it was not as rigorous as it is in the UK. However, Chinese and Asian students noted that as most courses only required students to consult one textbook, referencing was seldom required. Due to most Asian and Chinese students either not having done coursework, or at best only having completed one or two non-essay based pieces, it is more revealing to look at how serious they **judge** cheating in coursework to be rather than their previous practices (**action**). As Table 1 indicates, 40% of Asian and 30% of Chinese students did not judge copying material word for word as being serious.

		Asian	Chinese
Action	**Once or more**	75%	56%
	Never	25%	44%
Judgement	**Not or trivial cheating**	100%	60%
	Somewhat or very serious	0%	40%

Table 2: Copying a few sentences of material without referencing them.

Table 2 highlights that both student groups judged copying a few sentences word for word without referencing it as being not or trivial cheating, with 100% of Asian students viewing this as not being cheating or only being trivial cheating, while for the Chinese students approximately two thirds of the students saw copying a few sentences of material without referencing them as being not cheating or trivial cheating. This indicates, not only that copying several sentences is likely to be endemic in coursework submissions, but also that it is not seen as being serious or unacceptable practice by either group of students.

Due to the limited coursework that most students had undertaken in their home country this only emerged as an issue for a small number of the Chinese and Asian students. Based on their undergraduate experiences in Asia and China, coupled with their experiences with coursework since arriving in Lancaster, several

students suggested that plagiarism might often be unintentional due to the way they make notes while researching their essays. They explained that in the process of researching and drafting an essay, they collect numerous electronic and non-electronic references, keep several windows open at one moment in time, and copy and paste between them. They recognised that this could be dangerous in terms of not clearly identifying the work of others, losing track of the different sources, or alternatively, very tempting to pass it off as their own work.

In relation to the essay writing practices of students (Table 3), between 50 – 75 % of the Asian and Chinese students *judged* receiving unpermitted collaboration from fellow students in their coursework to be trivial.

		Asian	Chinese
Action	**Once or more**	25%	40%
	Never	75%	60%
Judgement	**Not or trivial cheating**	75%	50%
	Somewhat or very serious	25%	50%

Table 3 Receiving substantial, unpermitted help on an assignment.

Marks were seen by the Asian and Chinese students to be the main pressure they experienced that led them to cheat. All Asian and Chinese students concurred that competition was fierce at their previous institutions. In China, though high marks were seen as important so as to undertake an overseas postgraduate programme, they were also important in terms of finding a good job. Chinese students suggested that it was due to this that students felt they may need to cheat, as one Chinese student mentioned, *"Marks mean everything when students have no work experience. Marks are the only thing that companies judge you on."* Asian students reported similar views.

	Asian	Chinese
from parents or other family	40%	50%
to get into a graduate program	40%	60%

Table 4: Pressures that motivate students to get good grades

Table 4 supports these qualitative views, highlighting that 60% of Chinese and 40% of Asian students viewed getting good grades in order to undertake postgraduate study as being fairly or very important. When asked about family pressure to achieve high marks, this was seen to be significant among Asian and Chinese students, where 40% of Asian students and 50% of Chinese students saw family pressures as being fairly or very important. This was explained to have led several students to feel alienated from their educational context. Alienation was also attributed to the emphasis on memorisation, which some students viewed as being meaningless. This was compounded by some of the books and material that was presented to them being out of date. This resulted in students being output (marks) rather than process (learning) orientated. The feelings of alienation and disaffection from their educational context assists in explaining why it is that though Chinese and Asian students believe cheating is wrong they still engage in it in quite an extensive way. Interestingly, this shared sense of alienation resulted in a strong degree of collegiality among students. For example, collaboration in tests and exams was said to be common in all of the Chinese and Asian countries represented.

4 DISCUSSION

This penultimate section will consider the issues that our empirical insights and the literature to date presents to the use of electronic detection systems such as Turnitin for students from developing counties. For the purpose of clarity, we have separated these into five issues, though each are related.

4.1 Detecting Copying Not Plagiarism

Our study and the literature highlights that for a number of cultural and historical explanations, students from China and the rest of Asia may be predisposed to copying words and utilising them in their own coursework submissions. This has been highlighted as being due to a number of culturally laden reasons. First, authors and teachers are viewed as being authorities on subjects, and consequently are perceived by Chinese students to be the only people authorised to have a view on a particular subject. This is akin to Moore's (1997) finding that Asian students view texts as containing information rather than representations of particular views on the subject matter. Secondly, the literature and our primary data, indicated that for Chinese and Asian students, memorising texts and repeating them verbatim in examinations and coursework has been the focus of their learning experience throughout all levels of education. Third, it is very likely that students, who are novices in academic writing, may present their work through patch writing, as this is the approach they have traditionally adopted when completing their coursework essays and reports. Finally, our empirical research, which is supported by some literature, suggests that students are ignorant to the conventions and requirements for academic referencing.

It is important that we state we are not making any judgement that this approach to teaching and learning is inferior to that in the UK, merely different. However, it does imply that Chinese and other Asian students are culturally predisposed to copying words, and as a consequence, with the introduction of plagiarism detection software applications, students from such developing countries are likely to be detected. It is important to note that plagiarism detection software applications do not detect plagiarism, only copies of texts. However, we suggest that due to such culturally embedded practices, it is undesirable—one could even say wrong—to take a simplistic view of plagiarism that equates copying with plagiarism, as it is more than likely that there may not be any deliberate intention to commit malpractice. In this sense we note that it is important to recognise that the interpretation of the reports that plagiarism application software applications provide, needs to be made with a detailed understanding of the above. Otherwise, the documentary evidence highlighting the extent of the text that has been copied may significantly influence decisions and judgements being made by individual academics. This also raises the question as to how these culturally informed insights might be disseminated to those academics making decisions on cases of 'plagiarism' committed by Chinese and other Asian students.

4.2 Situating Copying and Arguing

A further important issue emerging from the literature and our empirical study is that even when students from developing countries such as China and the rest of Asia become aware of the different assumptions and expectations pertaining to borrowing words they will not have sufficient skills to differentiate between the nuances of what is or is not deemed plagiarism, nor will they have developed the skills and experience to move away from patch writing. One reason for this deficiency of skill is the different nature of the assessment that is likely to be asked of them. In China and the rest of Asia, our empirics and the literature reviewed indicates that students do not have much experience of completing coursework, and further, the experience that they have is more likely to be in writing what Shi (2004) terms summary pieces. These are typically summaries of 'objective facts' contained in one textbook. In contrast, when studying in the UK, they are required to write opinion pieces – where they are expected to form an argument. This means that in contrast to their history of relying on one textbook, in the UK students are expected—especially at postgraduate level—to be able to read material from multiple sources and distil from it the important points, arguments and issues. In Western Countries, students are typically expected to give a critical account of the literature and to be able to formulate their own position, with regard to the material, which they must be able to justify. They need to provide clear evidence of critical evaluations and reference to

appropriate sources. Further, they are often expected to present and support these views openly through discussion and questioning in a group or lecture context. However, for Chinese students whose previous educational context did not legitimate the development of their own views and arguments either in the classroom as Turner (2000) found, or in their assessments as was evident in our empirics and in the literature review (LoCastrol & Masuko, 2002; Pennycook, 1996; Introna & Hayes, 2004), adjusting to a different normative context that values the development of their own academically substantiated opinions is likely to be not only confusing, but also difficult. It is important to recognise that learning is profoundly connected to the context that it takes place within (Lave and Wenger, 1991). From this perspective we would argue that due to the significantly different normative contexts in which learning takes place, it is perhaps inevitable that Chinese and Asian students will be detected and identified as 'plagiarists' when studying overseas. When texts are submitted to a plagiarism detection service such as *Turnitin*, rather than merely relying on the acontextual evidence of the report, further contextual investigation may suggest that the student is in the processes of experiencing and learning how to write an argument and opinion based essay, and how to become a member of a community that has very different practices (Lave and Wenger, 1991). Thus, the inappropriate use of detection systems may be detrimental to the learning and development of some overseas students.

4.3 Emphasising Detection at the Expense of Education

We might also suggest that if plagiarism detection software is introduced with the intention to detect 'plagiarism' (as the name suggests, the emphasis is most often on the detection of assumed plagiarism, rather than the identification of copied text for educational and development purposes) then this is likely to limit the opportunities and time that students have to learn how to write in the new western, not to mention subject specific, educational context. Lave and Wenger (1991) note that for learners to develop the abilities of experienced participants—in our case students that are skilled in presenting arguments in this context—they must first be provided with time to be able to observe and participate in the practices of that community. However, the use of detection software from the outset, and the typical university penalties that may ensue, do not allow the time and possibilities to experiment with writing their argument and opinion-based pieces. Indeed, this early state of their educational experience in the UK is likely to be crucial, as Lave and Wenger (1991:36) warn that newcomers need to see the value of them becoming full practitioners in order for them to participate. Indeed, the emphasis on detection is likely to hinder overseas students' chances to learn the expectations and reasons for these values. Without providing legitimate opportunities to learn how to write, by for example observing and discussing the approaches to writing with others, the opportunities to learn are reduced with potentially disastrous consequences for the student. The issue of the time required to access, observe and participate in a community's practices is heightened by the fact that most Chinese and Asian students are on intensive one year postgraduate courses—as such they neither have a great deal of time to learn how to write in the appropriate way, or if 'detected' have insufficient to learn and ensure that it does not happen again.

4.4 Discriminatory Detection Systems

A further concern that the introduction and use of plagiarism detection systems may bring is that they might be discriminatory against students whose first language is not English as opposed to those native speakers. This cultural mismatching of context and skills in learning becomes more acute when student essays are batch submitted for checking and a threshold as a percentage of a document copied is set quite low (as one can do in these systems) for cases to be further investigated. Chinese and Asian students are more likely to borrow large strings of words as they seek to 'retain the master's voice,' or they may lack the familiarity with formulating opinions rather than merely summarising, or their citation skills may be limited. In contrast, UK students would often consciously paraphrase the words and arguments of others—without referencing them—so as to try to disguise their plagiarism (Shi, 2004). By doing this they are likely to ensure that they are pushed down below the line of detection, and in so doing, ensure that non-native students are detected

Indeed, Shi's (2004) study found that native speakers will be more able to use patches in such a way that they may be identified as paraphrases rather than direct copies. This is particularly important for electronic detection, as they are based on the principle of character sequence detection meaning that it can only identify plagiarism where there is an exact copy made of a string of characters (irrespective of location on the page). This sort of detection will obviously tend to show up those students who tend to retain exact

copies of phrases or sentences. It will therefore not detect those that deliberatively copy structure, arguments or ideas but express these in 'their own words". Thus, plagiarism detection systems operate with the assumption that to plagiarise one need to use the exact words of another, yet this assumption favours the native speaker and disproportionately penalises the non-native speaker. Through their careful use of synonyms and slight changes in the structure of sentences, the native speaker can remain undetected by the software's algorithm. Such subtle changes require a sophisticated linguistic ability far beyond the level of a non-native speaker. It is evident that if the task of plagiarism detection is delegated to algorithms then there is a strong possibility that this might be creating the conditions for constructing international students as plagiarists and allowing the native speaking plagiarist to remain undetected.

4.5 Discrimination and Alienation

A serious implication that may arise from the inappropriate implementation of detection systems that disproportionately identify overseas students as being plagiarists is that they may lead to further detailed scrutiny of non-native students. In contrast, those native speaking students that have consciously plagiarised are likely to remain undetected, and escape any further scrutiny. This is not only an act of discrimination, that is likely to result in unfair disciplinary sanctions in western universities such as expulsion or significantly lowered grades, but perhaps more fundamentally, could lead to students feeling alienated. This alienation may result in students adopting an output (marks) oriented approach, as may have been the case in their home country. Thus a major concern that arises with the introduction and use of electronic detection systems is that with the emphasis being on detection, rather than assisting students from non western countries develop their academic writing abilities, then it is only likely to add to their sense of alienation. As major actors in the network it is as much the responsibility of academics in the UK to address these conditions, as it is the non-western students' responsibility to respond to such attempts.

5. CONCLUSIONS AND IMPLICATIONS

Let us summarise our argument. Students from other cultures (in particular developing countries) arrive in the UK educational system with a disposition towards academic writing where exact copies of parts of prescribed texts or lecture notes are included in the texts they submit for purposes of assessment. This form of writing is often encouraged and sometimes expected from students. When they enter the UK system they are expected to submit academic writing that contain an independent substantiated argument that is properly referenced. As such they find themselves in a community that has substantially different practices and values, to the point that some of their previous legitimate practices are illegitimate and even seen as 'cheating'. They try and cope with these new practices by imitation, often borrowing exact phrases and words they feel unable to express. They tend not to value this as inappropriate behaviour as this was mostly seen as legitimate in their previous educational context. In trying to cope they fall foul of the plagiarism detection software that identifies their use of exact phrases as 'plagiarism'. In this context plagiarism detection systems may unwittingly serve as a mechanism to construct them as 'plagiarists' since:

- These systems are often implemented with the assumption that copying is equal to plagiarism
- They are often implemented with the intention to 'catch' presumed plagiarists rather than with an intention to support new members in a community of practice trying to copy with radically new practices and norms
- The way detection systems detect (by detecting exact copies) means that non-native students become disproportionately identified and scrutinised, creating a stark contrast between them and those that plagiarise without using exact copies.

This disproportionate scrutiny may increase these students' sense of alienation leading them to turn to the very practices (of actual plagiarism) that UK universities were hoping to steer them away from.

If this argument is correct—as we hope we have demonstrated—then the plagiarism detection systems in UK universities may be constructing plagiarist rather than improving academic integrity. In fact it may make academic integrity more elusive. We suggest that plagiarism detection systems need to be implemented within a completely different frame (Orlikowski & Gash, 1994) than is currently the case. The current frame of 'detection and discipline' must be replaced with a frame of 'development and support.' Specific activities that may be introduced to support the establishment of this frame may include introducing students to what is understood as plagiarism in the UK. Students could complete exercises that

allow them to practice paraphrasing, referencing and importantly, how to formulate arguments, and how the work of others is utilised to substantiate and support these arguments. Further, electronic detection may be used to support this development process, allowing students to determine which copied text should be in quotation marks, and which needs to be paraphrased. This may assist students, along with guidance and advice from tutors, to gradually move away from their long established patch writing practices. Academic staff for their part needs to better appreciate the steep learning curve required of overseas students, and in turn, assist their students in adjusting to the UK higher education system. This may include a recognition that plagiarism should not necessarily be equated with cheating, and further, some plagiarism such as patch writing, is central to the development of overseas students. By raising awareness of the challenges faced by non western students in the UK among academics, this should assist in avoiding students feeling as alienated from the UK educational context as they may have been in their own. Without initiating a 'development and support' frame, detection systems in UK universities may indeed be a micro-politics of power in which the legitimate interests of learning and education become translated into a system for the production of illegitimates members with enormous personal implications for those that become unjustly excluded.

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Rural Community and Human Development through Information Technology Education: Empirical Evidence from Western Nigeria

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ABSTRACT

In developing countries, IT education is associated with high cost and is not typically available outside urban areas. Seeking IT education might not be on the priority list of countries battling numerous problems that related to health care, housing, nutrition and other basic needs of life, but globally, IT education is undeniably an increasingly important aspect of human resource development, which is in turn crucial to economic development. This paper presents a case where the provision of IT education does not follow conventional thinking that associates IT education with urban dwellers. We discuss the case of Summit Computers in a rural community in Nigeria. The analysis of the case suggests that for developing countries to benefit from advances in IT, the following factors can be helpful: awareness among the real users (irrespective of the urban or rural residence and income status); convenient, affordable IT education in rural and urban settings; and consideration of how IT training can meet the needs of local employers. We also find that IT education can be effectively championed by a member of the local community, and the primary motive of IT education should be for development. This case suggests that government should consider encouraging community-based IT education initiatives in a bottom-up approach as contrasted with the current top-down approach that may be hindering the delivery and acquisition of IT education.

1.0 INTRODUCTION

As the global economy is gradually transforming to a knowledge economy and with the reality of globalization, the role of information and communication technology continues to gain more significance (Castell 1996). The era when the effect of these phenomena is limited to western industrialized countries or the urban capitals of developing countries is passing (Mbarika et al. 2002). There have been arguments that IT can provide solutions to problems of rural areas (Richards 2004) in terms of socio-economic development (Avgerou 1998, Madon 2000) and empowerment (Strover et al. 2004, Dawson and Newman 2002). According to Hollifield and Donnermeyer (2003), access to these information technologies will be necessary for rural communities to attract and retain businesses and thus remain economically viable in the 21st century. The use of information and communication technology has spread to every corner of the globe, albeit not in the same proportion (WDI, 2004). From downtown Manhattan to rural parts of Karnataka, people are utilizing these technologies for various purposes from monitoring stock prices to monitoring weather for agricultural purposes to getting services from government. Likewise many organizations are promoting and supporting the creation of local entities that would make ICT accessible on an affordable basis to everyone (Roman and Colle 2003). While many people in western industrialized countries can afford to acquire a computer system at home or live in a community that provides access at the local library, cyber cafes and similar centers are fast-growing alternatives in developing countries. Local businesses and organization know the importance of IT to their businesses even though it may not be readily available.

Despite the importance and real need that ordinary people have found for IT, many still lack an adequate education to take advantage of the benefits. The digital divide is not only between western industrialized

countries and developing countries, but is an issue that can be present within a country, between rural and urban dwellers, or even within areas in urban centers (Kvasny and Truex 2001, Kvasny and Keil 2002, US department of commerce 1995). Significant proportions of people in developing countries live in rural areas (e.g. 84% of Nigerians) and in poor areas of urban cities. Usually, rural areas are also characterized by low population density, which translates to low demand level for IT education relative to concentrated urban areas (Hollifield and Donnermeyer 2003). These are areas where business-minded, profit-driven entrepreneurs are not likely to site an IT education center. In many countries, IT education is largely private sector driven as IT education is not part of the curriculum at primary and post-primary public institutions, or even at many post-secondary government institutions[4]. Further, IT instructors with adequate skills are mobile and more likely to live in urban areas. For all these reasons, IT education is not readily available in many areas in developing countries.

The outcomes generated by community informatics - strong democracy, social capital, individual empowerment, sense of community and economic development (O'Neill 2002) are directly relevant to the expected outcomes of IT education, yet the focus of community informatics (O'Neil 2002, Grabill, 2003, Warschauer 2003) has not been on provision of adequate IT education to rural dwellers but more on IT content and access to IT infrastructure. The issue of IT education at the local level has been largely overlooked in IS research.

The purpose of this study was to investigate the concept of IT education centers in rural areas. The study specifically seeks to address the following questions:

- Why is IT education not readily available in rural areas in developing countries compared to the urban centers?
- How is IT education contributing to human and rural community development?
- What is the motivation of the founders of IT education centers in rural area?
- What is the most appropriate strategy to promote IT education in rural areas to improve human development?

In this paper, we examine the concept of IT education, with special reference to developing countries. We characterize rural areas in developing countries and summarize how human and rural development issues relate to IT. In the analysis of the case, we discuss how the efforts of the case organization contribute to human and rural development. We consider the motivations for establishing the IT education center, the challenges and opportunities and the lessons that could be learned from their experience. Finally, we make some recommendations for policy-makers and present ideas for future research and practice.

2.0 IT EDUCATION

2.1 Basic Concept

Reichgelt et al (2004) define IT as an academic discipline which focuses on meeting the needs of users in an organizational and societal context through the selection, creation, application, integration and administration of computing technologies. The Society for Information Technology Education (Lunt et al. 2003, Reichgelt et al. 2004) listed some skills and capabilities for information technology graduates, e.g.

- Use and apply current technical concepts and practices in the core information technologies,
- Analyze, identify and define the requirements that must be satisfied to address problems or opportunities faced by organizations or individuals
- Effectively design IT-based solutions and integrate them into the user environment taking into account user-centric design and interface,

[4] Our focus in this paper is the provision of IT education outside the formal educational systems like University, Colleges and Polytechnics

Thus, any kind of training and education that sought to provide people with those skills and capabilities (see SITE 2003 for details) could be considered as IT education.

2.2 IT Education in Developing Countries

The challenges that have been identified (Moyo, 1996; Barata et al., 2001; Darley, 2001, Morales-Gomez and Melesse, 1998) as the main constraints in IT development also apply to IT education (Shakya and Rauniar 2002, Bada et al, 2003, Okunoye et al 2003). Major challenges focus on expertise, infrastructure, funds, policies and regulations, literacy level, and income distribution. Like other development issues that recognize some differences in urban and rural centers, provision of IT education is particularly problematic in rural areas of developing countries. The reason for this can be attributed to the elite nature of information technology as well as basic literacy prerequisites that elude many residents of rural areas in developing countries.

IT education centers are usually concentrated in urban centers where most of the white-collar jobs are also available, which reflects the impression of IT as a business tool in many developing countries. It is not until recently that IT has begun to be utilized by governments and public organizations in developing countries, and thus to have a greater direct impact on the local people and society in general. In a real sense, there are no genuine incentives for private investors to locate IT education center in rural areas of developing countries. Although one could argue that education is a public good and that it is the responsibility of government to ensure its provision at all levels, IT education is not considered as part of the standard curriculum in many developing countries and its provision is left to the elite in the society.

Nevertheless, many rural communities have begun to embrace IT and its applications. The influence of the Internet cannot be over-emphasized in this regard, and globalization and internationalization of labor have also contributed to a greater awareness of the wide potential of IT. Many immigrants that live abroad encourage family members in their home country to have an e-mail account as a cheap alternative for communication, and use IT for money transfers and other purposes.

While access must precede adoption and use, according to Hollifield and Donnermeyer (2003), it is only economically viable for service providers (IT education and others) to invest in the infrastructure required to provide access (and IT education) if they can expect a return on that investment in a reasonable period of time. The low population density of rural areas and other factors makes it difficult to recover those investment costs and thus discourages a typical investor from providing IT education in rural areas. Since not-for-profit IT education centers are rare, residents of rural areas are generally denied the expected benefits that accompany IT knowledge.

3.0 CHARACTERISTICS OF RURAL AREAS IN DEVELOPING COUNTRIES

Both the population and labor force of developing countries are far more rural than is the case in developed countries. In Africa as a whole, for example, about 70% of the population lives in rural areas, compared with 25% in North America. Even more revealing is the fact that 68% of Africa's labor force is employed in agriculture, compared to a mere 3% of North America's labor force (Todaro 2000). Low productivity in agricultural production means that while 68% of Africa's labor force works in agriculture, agriculture accounts for just 20% of the continent's GNP, and the great majority of agricultural work is basic, subsistence agriculture.

Rural areas in developing countries are currently facing a number of particular challenges such as hunger, de-population, and declining agriculture, lack of employment opportunities, social exclusion, poor infrastructure and environmental degradation (O'Malley 2003). Per capita food production in Africa has actually declined steadily since the 1970s, and since food imports have not made up for the decline, this has indeed meant that the typical African has experienced a fall in food consumption over the past few decades. One author has summarized the reasons for this decline as "insufficient and inappropriate innovation, cultivation of marginal and sensitive lands, severe deforestation and erosion, sporadic civil wars, and

misguided (incentive-reducing) pricing and marketing policies—all of which were exacerbated by the highest rate of population growth in the world" (Todaro 2000).

Nigeria, in which our case organization is located, is typical of many developing countries in a number of aspects. It is mostly rural (84% of the population resides in rural areas), yet there has been a dramatic trend of people migrating to urban areas, which has resulted in the growth of at least 24 cities with populations in excess of 100,000. Its economic reliance on exports of primary products (in the case of Nigeria, this has been largely oil exports since the 1970's) has led to a serious neglect of the agricultural sector. The stagnation in rural areas and the rural-to-urban exodus has led to a severe unemployment problem in urban areas, with both rural and urban areas experiencing widespread poverty (Todaro 2000). Overall, Nigeria's public spending on education as evidence of its commitment to education has been ranked as near the bottom when compared to other countries (UNDP 2003). At the same time, an economic elite has emerged, causing large disparities in income and standards of living, including on a regional basis. Thus, the per capita income in a relatively rich state, Old Bendel (Delta and Edo state) is five times greater than that of a poorer state, Kaduna, and similar disparities exist in adult literacy rates (Todaro 2000).

By all accounts, there is truly a crisis in rural Africa. In the effort to formulate responses to the urgent problems facing developing regions such as in Africa, it is understandable but unfortunate that the possible contributions of IT have been largely overlooked. We now turn to a consideration of the connections between economic, rural, and human development and IT.

4.0 HUMAN AND RURAL DEVELOPMENT AND IT

The vitality of rural areas is crucial in determining how successful developing countries are in their efforts to promote human development. The United Nations' Human Development Report clearly outlines the connection between rural and human development (UNDP 2003). When agricultural productivity is rising, this increases households' nutrition and income levels. Rising incomes allow households to invest more in children's education and health, and also make increased public investments in areas such as health, education, transportation, communication, and other infrastructure more likely. Rising incomes and education levels also lead to declines in fertility and further investments in higher productivity agricultural and manufacturing techniques, constituting a positive upward spiral.

Conversely, when agricultural productivity is stagnant or even falling, as is the case in Africa generally, the spiral can be downward: low productivity in agriculture combined with high population growth lead to deforestation, erosion, soil depletion, and water scarcity, which in turn lead to further declines in productivity. Resulting low incomes and malnutrition inhibit efforts to increase education, health and other public services and investments. Fertility and infant mortality remain high, while investments in agricultural and manufacturing productivity remain low (UNDP 2003).

In light of these problems of the utmost gravity, is it not frivolous to talk of the need for IT and IT education? When people are lacking the very basics in terms of clean water, food, shelter, and health care, how can we advocate for funding for IT? As the United Nations Development Programme (UNDP 2003) points out, we cannot ignore technology, since technology will play a crucial role in raising productivity, thereby changing the downward spiral presently operative in Africa into a positive, upward spiral. We already have the technological knowledge to address many problems in the areas of hunger, water supplies, disease, and sanitation, but the developing world awaits new technological innovations to address problems such as HIV/AIDS, malaria, and the need for low-cost energy. The majority of technological advances today, including the dissemination of new knowledge, are intimately linked with access to, education in, and use of IT. Without significant progress in the IT area, spreading existing technological knowledge and creating new technology will be difficult or impossible. Thus, this is a task that cannot wait, in spite of the many other urgent issues facing Africa today.

As the Nobel Prize winning economist Gunnar Myrdal has said, "It is in the agricultural sector that the battle for long-term economic development will be won or lost" (Todaro 2000). IT and IT education have

an important role to play in this battle for human and rural development. This argument is, we believe, further strengthened by the case study presented below.

5.0 CASE STUDY METHODOLOGY AND DATA ANALYSIS

We use a single case study to investigate the IT education in developing country and how IT education is contributing to human and rural development. Since there is a scarcity of empirical research on the issue of IT education and human and rural development, the use of case studies seems to be an appropriate approach of investigation (Benbasat et al. 1987). Case study has also been noted as suitable for theory creation where theory is at an early formative stage and for practice-based problems where the experiences of the actors are important and the context of action is critical (Eisenhardt 1989; Benbasat et al 1987).

In support of case study, Yin (1994) considered investigation of a contemporary phenomenon or event in its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident. In a case study, the researcher does not, or cannot, control or manipulate the situation. Admittedly, interpretation could introduce bias, and affect the outcome of the research. Another limitation of case study is in its generalizations of the findings, however, case study does not necessarily provide a generalized result but it could be basis for informed knowledge

In selecting the case organization, we looked for a rural organization in a developing country with IT education as the main activity. The study primarily used semi-structured interviews, short time on-site observations and narrative of the main actors in the case organization. Apart from the information provided by the case organization on the developmental influence of IT education, the authors independently investigated theses influences to achieve triangulation of data and insights.

6.0 THE CASE ORGANIZATION: SUMMIT COMPUTERS

Summit Computers Ltd was established in 1997. It is located in Iragbiji, Oshun State, Nigeria. Iragbiji is a rural community in southern part of Nigeria. Agriculture is the predominant occupation of the dwellers. Iragbiji is about 10km from Osogbo, the capital city of the Oshun State. The population of Iragbiji is estimated to be about 30,000 according to 1991 Census. Summit Computers was established by Chief Muraina Oyelami, the Eesa of Iragbiji. According to Chief Oyelami, Summit Computers was established to create IT awareness in the rural populace thereby discouraging the influx of rural dwellers to the urban areas, and thus is intended as his contribution to community development. At Summit Computers, the courses include general information technology studies, data processing, programming languages, Internet, and application packages (including PowerPoint, MS Word, Front Page, Pagemaker, Excel, and CAD). The primary goal is to expose the community to the science of computing and information technology in general. The main motivation behind the establishment of Summit Computers came from Chief Oyelami's own personal love for IT education.

Summit Computers offers different levels of training for individuals, including children's programs, introduction to computer studies, secondary school leaver programs, university graduate and mature or working class/civil servants programs. To date, Summit Computers have produced more than 500 graduates. Some of the graduates went back for more advanced study in information technology, and others got jobs in their areas of interest. Most of them graduate with diplomas while a few (especially, the desktop publishing students) graduated at certificate level. Some graduates reported they became gainfully employed specifically because of their computer literacy. This confirms the idea that graduates stand a better chance of securing a job if they are IT literate, regardless of their discipline.

At Summit Computers, the students are trained using a syllabus designed in collaboration with Obafemi Awolowo University[5] Consultancy Services (UNIFECS). UNIFECS acts as an external regulating and

[5] A national university in the same state as Iragbiji

examining body, managing all the examination scripts and grades and directly awarding the diplomas and certificates. This approach is being used to legitimize the training and provide security and industry recognition for the graduates, and shows the importance of connections between the formal and informal sectors. As one observer has noted, "Employers are always suspicious to see a diploma from a computer school in a remote and rural area" (Oyelami 2004).

The major problem confronting Summit computers is mainly in the area of finance. The founder related that he has been subsidizing the training and providing most of the equipment: "We have not made any profit in our seven years of operation and the finance issue is really affecting our growth" (Oyelami 2004). Summit Computers started with a few used Intel 386 processor-based systems but their stock of computers has been increased with many 486 and Pentium processor-based systems. However, the need now is for more systems with faster processors to accommodate new applications. Summit Computers is not supported by government funds in any form. Chief Oyelami believes that the Summit Computers model can be replicated elsewhere (contingent on funding, of course).

Among the success factors of Summit Computers is the consistency in the delivery of the training programs, despite all the challenges posed by the environment. Summit Computers has been able to design new programs in response to upgrades in application software. This is of course essential to the marketability of graduates. Another success factor is the low cost tuition fees, which enable the local farmers to be able to pay for the training of their children. Summit Computers has a positive impact on the community. For example, some of the current training staff at Summit Computers are alumni of the program. Some other graduates have established their own businesses, including business centers and cyber cafés. For the future, Summit Computers hopes to go beyond provision of IT education and venture into assembling low cost computers that will be affordable for rural dwellers. This will encourage many to seek IT education and thus promote the main objectives of Summit Computers. They also plan to move to a large and permanent location to accommodate the growing demand for IT skills.

6.1 CASE ANALYSIS: MOTIVATING FACTORS AND DRIVERS OF IT EDUCATION IN RURAL AREAS

We next discuss some factors that were notable in the case that might be indicators of success in IT education programs in rural areas.

6.1.1 Awareness and Exposure to Technology

In the case described above, the founder of the organization was exposed to western education and culture. Through his job and other interests, he often travels to western industrialized countries, is aware of current trends in information technology and also is able to use many applications. While most founders of IT education centers in urban areas are specifically trained in IT or have worked in IT in western industrialized countries, their rural counterparts may have only picked up IT skills through their interactions with their international colleagues and by virtue of their primary job requirements. In our case, Chief Oyelami is an experienced artist who collaborates with many international artists and attends exhibitions, workshops and training sessions abroad. He acquires most of the knowledge through his contacts and in the course of doing his job, which lies outside of IT but nevertheless utilizes IT.

6.1.2 Technical ability

Awareness and exposure to technology is complemented by the development of technical capability. As expressed in the case, usually in these rural areas, there is a lack of IT expertise and thus it may be difficult to get qualified IT trainers. The cost of hiring and retraining personnel would defeat the whole purpose of

low cost education provision. Summit Computers addresses this issue by hiring the program's alumni. In our case, the founder of Summit Computers is highly knowledgeable in IT use and applications, has a clear understanding of hardware and software selection, and is able to handle some basic installation himself. He renders these services free of charge to the training center, thus reducing the out-of-pocket costs incurred by the organization.

6.1.3 "Son of the Soil" Factor

In the Nigerian context (and we believe this is likely to be the case in many other developing countries), a founder of a rural IT education center will be likely to be well received in their community if they are actually from the area. Such an individual will typically be perceived as understanding the real needs of the people and thus will experience a higher level of trust. Ideally, organizers of rural IT educations centers will be close to the community, and will be well known prior to starting the IT education center. The community will then perceive the training center as their own and they will all work together to ensure its success. In our case, we believe the local origins of the founder have been extremely helpful, as illustrated by the following quote:

> "...Many of our graduates have voluntarily returned to render their services to the institute, some of them that we hired are glad with what we have to pay. It is all in the community spirit and expression of their support to what we are doing." (Chief Oyelami)

The founder of Summit Computer is also a high chief in the village. He commands respect and has been praised for his commitment to the village. He is close to all the local leaders and his intentions were credible to the people. If an external person would attempt IT education in a rural area, it is less likely to be well received even when it is completely free (as in the case of some NGO's).

6.1.4 Community orientation and Service spirit

Related to the 'son of the soil' factor is the community orientation. Without the genuine commitment to serve the community, there was no economic justification to site an IT education center in the communities described in this case. The founder would have primarily established his center in the state capitol, which was about 10 kilometers away, before considering his rural village. As he expressed during the interview, he considers Summit Computers his contribution to community development and not a profit making venture. Even though the use of this center might extend to other areas, it was originally planned to serve the people in the immediate rural community.

6.1.5 Financial capability

As we have already noted, the founder of this rural based IT education center started by investing his own personal equipment, efforts and financial resources, providing services without financial remuneration. This individual is operating on charitable motives, since he does not receive income from the center but instead lives on revenue from other sources (e.g., from sales of artwork). If any immediate returns had been expected from his investment in the IT education center, the center would have been forced to charge market fees and in the process, discourage people from attending. This would have likely led the center to fold without achieving its objectives. This case thus illustrates the difficulties associated with rural-based IT education centers that are conceived as profit-making ventures. Nevertheless, if such centers would require constant injections of capital from charitable sources, it may be less likely to sustain the activities. However, it is altogether possible that once rural IT education centers begun as charitable activities are well-established, they can demonstrate their benefits to the community and become self –sustaining. It is too early in the case examined here to make conclusions in this regard.

6.2 CASE ANALYSIS: MAJOR CHALLENGES AND OPPORTUNITIES

6.2.1 Infrastructure development

Based on this study, we note that providers of IT education and related services in rural areas may not be able to afford to build the base information infrastructure for a whole community and thus, the growth of IT education will still depend on individual providers operating on a small scale. As noted, unless providers are willing to donate time and equipment, there may be no IT education activities at all in rural areas. With the rural population in developing countries, the development of an information infrastructure would be extremely helpful in enabling the provision of IT education.

6.2.2 Support

The case we have presented shows that the IT education centers in rural areas can succeed with the efforts of committed and visionary, non-profit oriented members of the community. They may have to operate without any financial support from government, even including being tax-exempt, and without support from international donor agencies.

We believe that our case demonstrates that support from both the national government and international donor agencies could assist in expansion of these IT education centers and also encourage interested people in other communities to start IT education centers. Having said this, we want to reiterate that the success of IT education initiative still relies on the ingenuity of local people, and that aid from governments and outside donor agencies should not prevent local people from being the main actors.

6.2.3 Continuous Development and skill upgrade

Scholars examining IT education in developing countries in the 1990s (Odedra et al 1993) have noted that a dilemma exists with respect to human resource development when people in developing countries acquire IT education only to lose their skills shortly after training due to the lack of opportunities to apply and upgrade these skills. Some important aspects of IT training need constant application and updating to remain current and useful. This poses a major challenge to beneficiaries of IT education in rural areas of developing countries.

In our case, we did observe this problem. The graduates of the rural-based IT education center in Iragbiji, Nigeria are in danger of soon losing their skills. There are only a few places they can work within their community that would require application of IT skills. It is unfortunately the case that there are relatively few local jobs where their newly-acquired IT skills are needed and utilized. As the center's founder explains, "... Some of our graduates are gainfully employed on the merit of the knowledge. Most of these jobs are within the capital city. The demands for the skills in rural areas are low and that is affecting the demand for our programme." (Chief Oyelami) Also, since access to IT infrastructure in individual homes is almost non-existent, graduates are not able to apply and practice their skills at home.

Even some graduates that are able to utilize their IT education are not able to acquire new skills since they largely depend on their local center and the limitations of their workplace. The problem of how to allow IT graduates to continuously apply and upgrade their skills is of course highly connected to the problem of infrastructure discussed earlier. Increasing access to IT infrastructure will greatly aid the effort to utilize and improve skills. In this regard, the center in Iragbiji has begun to evaluate the feasibility of establishing a computer assembly plant where affordable computers and other devices could be produced. Bringing the actual production of IT equipment into rural areas could help extend the accessibility of IT infrastructure, provide further skills to local people, as well as address the problem of the affordability of IT equipment.

7.0 RECOMMENDATIONS AND CONCLUSIONS

Our findings from our case enable us to draw some parallels between IT education and IT diffusion in rural areas. For policy makers, we propose that they encourage elites that reside in rural areas to utilize their

experience and exposure to modern IT technologies to set up training schools in their community. Usually, these elites can afford to acquire their own personal computers, which they could use to train a small group in their local area. A member of the rural community with IT experience can also be encouraged to provide their expertise at low cost to train rural people, provided the local government administrators provide the equipment and other necessary resources. The participation of the local government in such a capacity could be to provide the formal structural component, which would in turn provide the context in which individual IT education centers would operate (Cancian 1981, Rogers 1995).

Although our focus in this paper is on the nontraditional provision of IT education, we recognize that the leveraging of the local education infrastructure that is already available in rural areas could greatly assist such efforts. Space in local education centers (primary and secondary schools, libraries, etc.) could be made available at little or no cost to local people who are willing to set up an IT education center. While it may not be feasible to make such programs totally free, such IT education in rural areas must remain affordable to the intended beneficiaries of the training.

Since this bottom-up approach can be effective in the delivery of IT education, we suggest that governments disseminate the success stories of existing rural based IT education centers to other rural areas. In such communication efforts, emphasis should be laid on the developmental implications and the benefits to the host communities. A local initiative can be more easily handled and managed than an initiative that was designed by an agency of central government (partially due to the many layers of bureaucracy typically present). There is also evidence that such initiatives can be considered alien to local people and thus reduce the chance of success. For example, the Mobile Internet Unit program of the federal government of Nigeria, which was meant to provide Internet connectivity to rural community, has not been very effective or popular. Similarly, the Computer- for all- Schools program in Nigeria has yet to place computers to many schools in rural areas. We conclude that a centralized approach to IT education may be inappropriate in Nigeria and likely in other developing countries with similar characteristics.

This essay has shown that IT education can be an essential factor in human development in rural areas. Emphasis has been placed on access to ICT, connectivity to the Internet, distance learning, and adoption of IT in previous research on IT and development. All these are not possible without adequate IT education, to which policy makers have paid inadequate attention. Multilateral and bilateral agencies have supported connectivity and access through various initiatives, yet very little has been done on IT education. Rural areas that want to take full advantage of IT for development purposes must find a way to support local initiatives that establish sustainable IT education centers. All the motivating factors and the challenges we presented need to be adequately considered. While IT has been long established as a driver of socioeconomic change and development, this study emphasizes the contribution of IT education to rural and human development.

Our findings suggest that locally sponsored IT education centers could be a valuable approach to IT education provision in rural areas. IT education that considers the needs of local businesses and organizations could attract local people and thus increase the demand and sustainability of such centers. The government could encourage the provision of IT education and support the promoters of such efforts without making IT education provision their primary responsibility (except when it is part of the formal school curriculum). As the world economy continues to be knowledge driven and with the influence of IT and globalization on these changes, we conclude that sustainability and development of rural communities in developing countries can be highly affected by the level of IT education.

While we have offered some interesting findings, this study is not without limitations that need to be considered in the interpretation and application of the recommendations. First, the study is based on one case in one country, and thus we cannot accept the findings as applicable to rural communities in general. However, a single case study is an appropriate methodology for exploratory purposes and where we have limited knowledge about the phenomena under investigation. We nevertheless do not expect any major variations in the settings and characteristics of similar IT education centers in other rural areas. Also, we were not able to include the perspective of the other actors in the communities (the students, local government officials, etc.) in the current case presentation, and would like to do so in future work. We believe the areas explored in this essay present important opportunities for future research, and that such

research promises to make significant contributions to knowledge relevant to rural and human development in developing countries.

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Institutions and ICTs in Makerere University: Bridging Digital Divide or Spreading Donor Dependence?

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ABSTRACT

Effective use of information and communications technologies (ICTs) by universities and other higher education institutions of developing countries can play a crucial role in developing their capacity as gatekeepers of knowledge-creation, distribution and use. Several governmental and non-governmental institutions support this. However, there is a need to identify what constitutes an appropriate role for these institutions and the impact of their intervention on developing and sustaining the ICT capacity of their recipients. This paper contributes to this debate by presenting the role and impact of institutional intervention in the Makerere University's ICT capacity and its contribution to human resources development.

1. INTRODUCTION

The use of information and communications technologies (ICTs) to support the core and auxiliary functions of higher education institutions (HEIs) is well recognised. ICTs can play key roles in shaping the management of the HEIs and redefining how routine administrative functions are performed (Valerie, 2000). In addition, ICTs can challenge the way education content is presented, extend the reach and richness of academic programmes and enhance the effectiveness and efficiency of course delivery (Jackson and McDowell, 2000; Levey, 2002). AAU (2000) and UNECA (2001) state that equitable access and meaningful use of ICTs by universities of developing countries (DCs) have a multiplier effect and a positive influence on human resources development.

In DCs though, harnessing the potentials of ICTs in the HEIs in general and for the purposes of human resources development in particular is not an easy undertaking. Most of the HEIs suffer from chronic under-funding, lack own income generating (or cost recovery) capability and are unable to attract and retain information technology (IT) skilled human resources (Okunoye, 2003; UNECA, 2001). In cases where the challenges of initial investments are addressed, ICT resources often become non-functional partly due to poor maintenance that was neither planned nor adequately budgeted for and partly due to high cost of ICT ownership that requires constant upgrading (Santhi et al, 2002). In other cases, where ICTs are acquired through aid/donation, the technologies often tend to be incompatible to existing resources and to spare parts available in the local market (Schware and Choudhury, 1988; Wanyembi and Barjis, 2002).

Because of lack of own resources and capabilities, the ICT development of HEIs relies on support from various home and international institutions. Over the years, many ICT transfer interventions to HEIs have taken place (Hafkin and Wild, 2002; OECD, 2001). However, their performance indicates a number of

shortcomings covering project design, training, monitoring and evaluation gaps (Baark and Heeks, 1998). There is therefore a need for more empirical cases and knowledge that assesses the nature of institutional interventions and the extent to which these have contributed to building the HEIs' capacity to exploit ICTs in planned, manageable and sustainable ways.

The purpose of this paper is therefore to explore the nature and impact of institutional interventions by taking the case of the Makerere University of Uganda. It will examine the impact of institutional support on the University's capacity and process of integrating ICTs in its human resources development and administration activities. The paper is based on King et al's (1994) institutional intervention and AAU's (2000) ICTs capacity assessment frameworks. King et al's framework was chosen because previous studies in both developed (Demsgaard and Scheepers, 1999) and developing (Montealegre, 1999) countries have established its relevance for understanding the dimensions of institutional ICT interventions.

2. THEORETICAL BACKGROUND

2.1 Institutional Theory

The study of institutions has both an economical and a sociological provenance. Sociologists focus on the notions of "sets of rules," and the conformity and convergence of governmental, non-governmental and business organisations and other actors to these rules for either efficiency or legitimacy reasons (Jessop and Nielsen, 2003:1). Economists, on the other hand, focus on the notions of tractable and relatively durable social and economic entities (such as groups, firms and organisations) that operate in inter-organisational, national and global networks and that perform certain activities to either encourage or discourage innovation diffusion (King et al, 1994:141). Within the ICT debate, institutional arguments take the form of understanding the intervention and impact of certain governmental and non-governmental organizations in ICT diffusion and use (Bada, 1998; Montealegre, 1999; Silva and Figueroa, 2002; Teo et al, 2003). Thus, in this paper, given our interest in ICT focused interventions, we follow King et al's (1994) notion of institutions as "entities".

2.2. Role and Intervention of Institutions

Of the institutions recognised by King et al (1994:148), this paper focuses on government agencies, multilateral and bilateral development organisations, foundation corporations, local and international private sector firms and universities from developed countries.

In the area of ICTs, several studies from both developed and developing countries have stressed the role of government agencies in stimulating ICT diffusion and use (Gurbaxani et al, 1991; Land, 1990; Molla, 2000). Some of these influences include investing directly in technological development, formulating policies, standards and regulatory frameworks, facilitating the development of local ICT industry, and showcasing ICT applications and use. Likewise, because of the putative link between ICT and socio-economic development and because of the multiplier effect of building the ICT capacity of DCs' HEIs, a growing number of donor agencies (multilateral and bilateral organisations, foundations and corporations), support ICT interventions in HEIs. These interventions take the notions of either bridging the digital divide or building digital opportunity. The general key spheres of donor influence are supporting infrastructure development, funding access and connectivity, human resource development, and providing hardware and software technologies (OECD, 2001). In some cases, it also includes direct involvement in designing, executing and managing ICT development programmes (Hafkin and Wild, 2002). Other institutions alike (such as universities of developed countries and the local private sector firms) intervene by providing grants, in-kind technical expertise, establishing inter-university and university-industry consortia and linkages (Levey, 2002).

King et al (1994) identify two forms of institutional interventions (*influence versus regulation)* and two innovation drivers (*demand pull versus supply push). Influence* initiatives have the purpose of changing the behaviour of those under the institution's way. This can be achieved without direct use of force or exercise of command through the provision of resources to encourage desirable actions. On the other hand,

regulatory actions have the purpose of directly and at times indirectly affecting the behaviour of entities under formal institutional jurisdiction. This can be done through directives or actions that limit options and modify behaviour. Either way, influence and regulation can result in different but related outcomes depending on whether *supply-push* (production of innovative product or process) or *demand-pull* (willingness to use the product) forces drive the innovation (King et al, 1994). On the basis of these two groupings of institutional actions ('influence versus regulation' against 'demand-pull versus supply-push'), King et al (1994:150) provide six general kinds of institutional roles that can either stimulate or retard ICTs innovation: *knowledge building, knowledge deployment, subsidy, mobilization, standard setting and innovation directives* (Figure 1).

2.3 Impact of Institutional Intervention

Assessing the outcome and impact of institutional interventions requires covering both the positive achievements and the unintended consequences of well-intended actions. On the plus side, key indictors can include capacity building in terms of basic infrastructure, initial start-up capital investment, bridging finance and skills gaps, and efficiency and effectiveness gains from ICT implementations (AAU, 2000; Hafkin and Wild, 2002; Levey, 2002). On the other hand, institutional interventions can potentially lead to *ad hoc* and haphazard adoption and implementation of ICTs, cultural mismatch, design-reality gaps and incompatibility (Baark and Heeks, 1998). It can also result in unsustainable and failed ICT project initiatives (Heeks, 2002). There is also the uncertainty of donor support (hence lack of innovation continuance and assimilation) and the impending danger of donor dependency syndrome.

In order to appraise the impact of the institutional intervention, we follow AAU's (2000) assessment criteria for ICT application in universities and other institutions of higher education in Africa. The criteria stipulate six areas of capacity indicators:

(1) *ICTs infrastructure*
(2) *ICTs financing*
(3) *ICTs training, research and developments*
(4) *ICTs application in administration and management, academic information (library) services and in teaching and learning*
(5) *ICTs planning and monitoring tools,*
(6) *ICTs organisational and management support infrastructure*

Figure 1: Dimensions of Institutional Intervention

	SUPPLY PUSH	DEMAND PULL
INFLUENCE	**Knowledge Building** Developing capability to appreciate ICT innovation and ICT research **Deployment** Education to create skill base for the production of ICTs **Subsidy** Alleviating or moderating barriers to innovation through direct funding, encouragement of capital markets and provision of tax benefits for investment in research and development **Innovation Directive** Direct institutional operation of production facilities for innovation I	**Knowledge Deployment** Initiatives (such as training programmes) to create technical capability to use ICT and develop critical mass ICT user base **Subsidy** In-kind provision of ICTs products and services. Direct or indirect provision of complementarities required for use and suppression of substitute products and services **Mobilization** Programmes for stakeholders awareness creation, sensitisation and promotion of ICTs II
REGULATION	*III* ***Knowledge Deployment*** Requirement to ICT education and training of all citizens/employees **Subsidy** Reduction in general liabilities for organizations engaging in innovative activity. Modification of legal, administrative or competitive barriers to innovation and trade **Standards** Establishment of standards under which innovative activity might be encouraged **Innovation Directive** Establishment of requirements for investment in R & D by organizations	IV **Subsidy** Procurement support for products and processes that facilitate adoption and use **Standards** Require particular products or processes to be used in any work for the institution. Require conformance with other standards that essentially mandate use of particular products or processes **Innovation Directive** Require that specific innovative products or processes be used at all times.

Source: Adapted from King et al (1994:151)

3. RESEARCH METHODS

The purpose of our study is to illustrate the role and impact of institutions on the ICT development process of Makerere University. There was therefore a *prima facie* case for using a single case study approach. However, the evidence from a single case study is often considered less compelling than from multiple cases study (Yin, 2003). This calls for caution in the interpretations and extrapolations of the research findings.

Makerere University, established in 1922, is one of the largest universities in the East and Central Africa with over 28, 000 undergraduate and graduate students. It has a total strength of over 1000 academic and 3000 non-academic staffs. Different institutions, namely donor agencies and development partners have been involved in Makerere's ICTs development. This makes Makerere a suitable choice to study the role and impact of institutions.

The study used several methods of data gathering: quasi-participant observation, key informants interviews and document analysis. The participant observer, with over 10 years of working experience as an administrator, planner and economist in the university, provided a retrospective account of the historical development of ICT, background of different initiatives and projects and actual interventions of institutions. To control for bias and errors (both observation and retrospective), the second author reviewed and questioned the observation (Golden, 1992). The process provided us with an in-depth insight into the workings of the University.

Key informant interviews were held with some members of the university administration. These included the deans of faculty of science and faculty of technology, the caretaker of the institute of computer science, the director of planning and development and the deputy director of the university's directorate for information and communication technology support (DICTS) unit. Staffs from the planning and development department were also consulted. These interviews served to capture views on the role of institutions in Makerere's ICT development, to verify and complement information collected from documentary sources, to assess the relationship between institutional support and Makerere's ICT capacity development and to identify challenges that the University is facing.

We also reviewed various print and electronic documents. Some of these documents include the University's Strategic Plan (2000/01 – 2006/07), the University's annual Reports (2001 and 2002), the ICT Policy and Master Plan (2001) and the Quick Scan Report (2000). The purpose was to get both historical account and state of the art perspectives on ICT development, and to explore links between institutional roles and ICT related changes within Makerere.

4. INSTITUTIONAL INTERVENTIONS AND MAKERERE'S ICTs CAPACITY

This section discusses the actions and roles of various institutions in stimulating ICT adoption and use at Makerere. The information on institutional actions (italicised in the text) is synthesized using AAU's (2000) ICT capacity indicators framework to bring out institutional regulatory and influence actions that developed or are in the process of developing Makerere's ICT capacity. Appendix I provides a description of the major institutions and their purpose for providing loans and grants.

ICTs Infrastructure

The dawn of computer use in Makerere started in the 1970s by the then Department of Mathematics in the Faculty of Science. But little tacit and explicit knowledge existed on the role played by institutions prior to 1991. In 1991, through assistance from International Development Research Council (IDRC), awareness was created to promote electronic communication *(mobilisation, subsidy).* IDRC also sponsored *(subsidy)*

the 'Fidonet initiative' (also known as the MUKLA network) that created a store and forward e-mail connectivity. But this did not last long because of expert withdrawal and lack of University sponsorship (Lishan, 1996; Nakanyike and Nansozi, 2001).

Between 1994-1999, more ICT awareness was created under the auspices of the World Bank-sponsored African Virtual University (AVU) pilot project (*mobilisation* and *subsidy)*. However, after the pilot phase that had ended in the year 2000, the AVU unit at Makerere has yet to build the capacity to run on its own without donor input. During this period, a number of faculty specific networks have also been developed through direct and indirect *subsidy* of institutions. Notable ones include the Faculty of Law's United States Agency for International Development (USAID) funded local area network (LAN); the Faculty of Technology's 70 user LAN and Faculty of Forestry's Norwegian Agency for International Development (NORAD) funded fully networked undergraduate computer laboratory (Nakanyike and Nansozi, 2001).

Makerere's quick scan survey (2000) indicated that by then there were about 730 PCs of various makes and capacities. Out of these, only 320 were networked in small LANs with no University-wide network. In a few departments, dial-up Internet access existed. There was very limited IT expertise. The most widely used operating system environment was Windows95/98 and Windows NT was found in a few cases only. Applications were dominated by office automation software. The report also indicated that 70% of the computers were more than three years old and were difficult to maintain and upgrade.

Post the year 2000, the university has set up Maknet--an optical fibre based campus-wide network--through a Government secured loan from the African Development Bank (*subsidy*). This network has a wireless connection to the Internet, initially courtesy of the USAID/Leland initiative and later supplemented by Swedish International Development Agency (SIDA) (*subsidy*). Local private firms such as Hewlett Packard and Lucent Technologies have provided in-kind *subsidy* in the form of bridges, routers and wireless equipment to support the network development (Makerere University Annual Report, 2001). The network is envisaged to link-up the decentralised faculty based LANs in a distributed mode (*standard setting*).

ICTs Financing

The university's history, like most other institutions in DCs, indicates that the development of ICT has been heavily *subsidised* by multi-lateral and bilateral organisations followed by government support. Table 1 provides a snapshot example of the level of subsidy. One shortfall of donor assistance is that in many cases it does not take into account other costs such as connectivity charges, the cost of general routine services, maintenance and upgrading, salaries to IT staff and users training. Such costs can be prohibitively high and affect the sustainability of ICT provision in the University. However, with privately sponsored programmes picking up, Makerere is encouraging individual departments (*standard setting*) to devise means of recovering costs and/or generating revenue through user fee charges.

Table 1: Snapshot Examples of Major Institutional Support in Makerere

Institution	Amount in US Dollars	Purpose
NORAD (Donation)	2,500,000	Sensitisation and information systems planning workshops, study visits; and development of administrative information systems. Procurement of hardware and software and construction of a five floor building for the Institute of Computer Science
SIDA (Donation)	850,000	Support to formulate Makerere's ICT policy master plan, design Maknet and ICT human resources development.

ADB (Loan to the Government of Uganda)	700,000	Developing university wide network including the procurement of hardware and software for the Institute of Computer Science and the main library.
Leland Initiative (Donation)	370,000	Setting up wireless intranet link for all faculties and administrative units.
Ugandan Government (counterpart funding)	150,000	For civil works in trenching and laying of the optical fibre cables for Maknet.
Education for Development and Democracy Initiative (EDDI) (Donation)	130,000	Restricted start up recurrent costs (such as salaries for key expertise positions not available in the University, access costs, training and maintenance)
USAID (Donation)	20,000	Conducting of feasibility study for the wireless connectivity
Hewlett Packard (In kind donation)	179,000	Donation of bridges and routers to support campus wide network
Lucent Technologies (In kind donation)	123,000	Donation of bridges and routers to support campus wide network
Rockefeller Foundation and World Bank	"17.6 m"	ICTs form an integral part of the total US$17.6m joint support towards capacity building in terms of better pedagogical and research services
Carnegie Corp. of New York	"5 m"	ICTs application is a partial component of the approximately US$5m support towards the University's institutional development programme.

Source: Makerere university annual report (2001, 2002) and ICT project extracts.

ICTs Training, Research and Development

Training of ICTs human resource specifically for the University's needs has not been given due recognition in the past. Rather, it has been sporadic and dominated by individual efforts even when the University established a full-fledged Institute of Computer Science. Major institutional actions in this area include NORAD's assistance to develop and equip the Institute of Computer Science (*subsidy and innovation directive*) and staff exchange and study abroad programmes (*knowledge deployment*); The World Bank's AVU initiative (*knowledge deployment*) and The World Bank's and Rockefeller Foundation's joint support for ICT research and innovation (*knowledge building*).

The government on its part formulated a national ICTs policy (*innovation directive)* that provides the framework to guide ICT innovations within the university. In addition, the government provided tax waivers for importing of computers and other related accessories.

ICTs Application

Over the years of Makerere's existence, all the administrative functions and activities have been manual. Like the majority of DCs' institutions, ICTs were mainly used for routine office automation and document processing activities. This further emphasises Mulira's (1995:95) observation that "despite the fact that computers were introduced in Uganda over 30 years ago, their utilisation has been confined to rudimentary tasks of office automation, accounting and personnel record-keeping". However, recent developments and institutional interventions appear to change this picture in Makerere.

In 1999 the Faculty of Law supported by USAID (*subsidy*) pioneered a "reengineering plan" that has gone as far as re-designing courses to teach students on the intersection of ICTs with Law (*Knowledge deployment*). Following the formulations of the ICT Master Plan, the University requires all academic departments to integrate ICT with their curricula both in the review of existing programmes and design of new ones (*innovation directive). Mobilisation* pursued a top down approach targeting first the top and middle management followed by sensitisation workshops, seminars and conferences involving potential users at the grass-roots.

As part of capacity building in the application of ICTs in teaching and learning, a team of selected academic staff from each of the 20 Faculties/Schools/Institutes had to undertake a one month training of trainers course in e-learning at Delft University in Netherlands with funding from SIDA (*knowledge deployment*). Likewise, the Ford Foundation funded the setting up of a Blackboard e-learning website, a collaborative linkage between Makerere's Faculty of Social Science and Tufts University.

By the same token, NORAD and the Carnegie Corporation of New York (*subsidy*) supported setting up administrative information systems namely the Financial Information System (FINIS), Academic Records Information Systems (ARIS), Human Resources Information Systems (HURIS) and the Makerere University Library Information Systems (MAKLIBS). The support also includes provisions for training staff and students in the use of these systems (*knowledge deployment*) and working visits (*mobilisation*) to universities in the region (such as the University of Daressalaam in Tanzania and the University of Cape Town in South Africa) and those abroad (the University of Oslo in Norway and Uppsala in Sweden).

ICTs Planning and Monitoring

In 2001, the government of Uganda revised its Higher Education Act and granted Makerere increased autonomy to manage and mobilise resources from all possible sources including international development institutions (*standard setting*). This was followed by Makerere's formulation of an ICT Policy and Master Plan. The ICT Policy and Master Plan provides a framework to enhance the University's capacity to utilise ICTs in all spheres of teaching, research and development and administration. As top priority, it stipulates strengthening and modernising the management, planning and administrative systems. Specifically, it outlines the need to consolidate and standardise data to improve information provision, communication and integration. It also stipulates that each unit in the university should make provisions for ICTs development (*innovation directive*). SIDA and NORAD provided funding (*subsidy*) that helped to solicit the service of external consultants (*knowledge deployment*) to assist the University in preparing the Policy and Master Plan.

ICTs Organisational and Management Support Infrastructure

Before 2000, the senate computer management committee was responsible for managing Makerere's computer resources. However as part of implementing the ICT Policy and Master Plan, the University set up the Directorate for ICT Support (DICTS) and a Vice Chancellor led ICT implementation committee (*innovation directive*). The directorate is responsible for coordinating and supporting the implementation of the plan, setting acquisition standards and ensuring their application and providing technical advice. The committee, on the other hand, plays a monitoring role.

The new organisational structure shows the emphasis the University placed on ICT. However, DICTS has yet to be staffed with permanent IT-skilled people. Most of the current staffs including the director and systems analysts are temporary on secondment from academic departments. The three engineers within the unit man the Network Operating Centre (NOC). Given the size of the university, the unit currently can only

afford to provide an advisory role and guidance (*standard setting*) to the heads of departments on ICTs hardware and software acquisitions while application development works are mainly outsourced.

Summary

The discussion of the institutional interventions in the preceding sections indicates that while most of the institutions have influential roles and operate on the subsidy (and mostly demand pull) domain, the Ugandan Government, Makerere University and other Universities in the West played regulatory roles by setting standards and innovation directives that encouraged the use (demand pull) and in rare cases provision (supply push) of ICTs. Overall though, the above discussion can be summarised (Table 2) by mapping the activities of the institutions along King et al's (1994) dimensional framework (Figure 1). The attempt here is to show the balance in terms of content (supply push versus demand pull actions) against the nature (regulation versus influence) of the specific activities. This intersection or point of balance affects the ICT development trajectories of a given country or organisation. Further, Table 3 summarises the impact (both intended and unintended consequences) of the interventions along the six ICT capacity indicators.

Table 2: Summary of Institutional Interventions in Makerere's ICTs Development

Dimension of Intervention	Nature and Content of Intervention				Institution Involved
	Supply push x Influence	Demand pull x Influence	Supply push x Regulation	Demand pull x Regulation	
Knowledge Building	ICT research and innovation; Quick scan survey				NORAD, World Bank, Rockefeller
Knowledge Deployment	Study abroad programmes, integration of ICT with the curricula, AVU	Users training, management seminars; training of trainers in using ICT in teaching and learning	Provision that all academic and relevant administration staff to be trained in basic use of IT		SIDA, NORAD, World Bank, Ford Foundation and Makerere
Subsidy	Tax waiver on computers and accessories imports	Network infrastructure development, donation of hardware and software; development of MakLIBS, FINIS, HURIS	Government's revision of higher education act and granting of autonomy	Government's loan from ADB for procurement and laying of network back bone	Government, USAID, Leland, SIDA, Local private firms, NORAD, Rockefeller, Carnegie
Mobilisation		Sensitisation seminars and workshops, working visits to other universities			NORAD, SIDA and Carnegie Corporation of New York

Standard Setting			National ICT Policy	ICT Master plan Standardisation of IT specifications; Conformance to bilateral organisations and donor demand	Government Makerere University
Innovation Directive	Fidonet, AVU, Institute of Computer Science, Maknet, wireless Intranet		Government granting of autonomy to Makerere ; National ICT policy	Requirement of each unit in the university to make provisions for ICT; ICT integration to academic curricula, use of admin systems	SIDA, World Bank, NORAD, Makerere University

Table 3: A contrast of Makerere's ICTs capacity and outcomes of institutional intervention

Capacity Dimension	Intended positive contribution (Achievement)	Unintended/or unfavourable consequences
ICTs infrastructure	Bridged the high initial investment resource gap for basic ICTs infrastructure. Between 2000 and 2003, networked computers rose from 300 to 2700; LANs from 15 to 40; bandwidth from 1.5KB to 2.5MB with a 16KM campus wide optical fibre.	Initially resulted in accumulation of incompatible and non-standardised ICTs equipment.
ICTs financing	Infrastructure and application development. The granting of autonomy by government to generate income and mobilise donor funding	Donor dependency, danger of unsustainability because of poor forecast of high maintenance costs
ICTs application in teaching learning, administration and research	The satellite link promises to pave the way for enhanced and efficient delivery of distance learning programmes. The various administrative systems are expected to lead to the overall improvement of the University. The University has now about 3000 ICT literate staff (up from 300 by 2000)	Sustainability of high tech based teaching and learning is questionable
ICTs planning and monitoring tools	Help in the creation of awareness and the institutionalisation of ICTs planning and management into the University set up	Initiatives largely dependent on donor funding and sustainability may be at risk.
ICTs organisational and management support infrastructure	Created the basis for a coordinated ICTs leadership and championship	Not well invested in creating skilled people to staff the structure.

5. DISCUSSIONS AND CONCLUSION

Effective harnessing of ICTs by universities of DCs and specifically those in Africa is beset with numerous challenges. Besides key inhibiting factors such as lack of organisational, financial and skilled human resources, reliable electricity supply and telecommunication infrastructures are yet to be adequately developed. It is this state of affair that creates the need for institutional intervention to fill up key resources gaps. The result of the study indicates that institutional intervention was instrumental for speeding up the acquisition and establishment of ICTs infrastructure; integrating it to teaching, learning and research and improving overall institutional efficiency. On the other hand, it also shows the extent of donor dependency.

As typical of late ICT adopters that are constrained by resources; the most populated domain appears to be *subsidy* with a focus on *demand-pull*. Subsidy provided by donor institutions and the government enabled and propelled all the other ICTs development components. Subsidy has also covered the initial investment capital to develop an ICT infrastructure. However, the uncoordinated way this was approached historically (prior to 2000) has resulted in a backlog of mostly outdated and incompatible computer equipments. The challenge facing Makerere was the ability to maintain, improve, and standardise ICT and ensure the enforcement of its standards. The formulation of the ICT Policy and Master Plan was therefore a significant stride in the right direction.

In terms of the balance between the production and use of ICTs, there is a bias towards demand-pull actions in all the dimensions of subsidy, knowledge deployment, standards and innovative directive. However, it is a balanced intersection of supply push and demand pull forces that build true ICT capacity and rarely does one succeed in isolation from the other (Molla, 2000).

The findings of this study also imply that building the ICT capacity of HEIs is crucial in human resources development. Success in this area (especially the application of ICTs in teaching, learning and research) can be translated in terms of improving educational curricula with wider access to a variety of information, increasing the reach of higher education (through distance education), creating flexible and learner-centred environment and cultivating ICT savvy graduates for all spheres of the economy. However, heavy donor dependence without mechanisms to create own financing and management regimes can affect long-term sustainability and undermine HEIs' effectiveness to play the above roles.

A number of lessons can be drawn from the results of this study. First, ICT capacity development in HEIs appears to work best with public-private-donor partnership. The coordination of the activities of these three parties would lead to better ICT production and use competency. Second, governments in developing countries need to grant increased autonomy to Universities to facilitate effective institutional transformation. Government support could take the form of reciprocating the initiatives of Universities by formulating conducive policies; minimizing or waiving taxes on knowledge related goods and services and providing counter-funding to finance projects. Third, Universities need to avoid unplanned and piece-meal ICT development approach. They need to strike a balance between short-term goals and long-term interests. In addition, as much as acquiring ICT hardware and software gadgets and securing top management commitment, effort should be spent to address soft issues and grass-roots support.

Finally, in order to minimize donor dependency, HEIs like Makerere University must devise alternative sources of funding. To ensure sustainability, ICT financing mechanisms have to be devised. These could be introduced in the form of cost-recovery by charging for ICT use and reduction in the cost of technology ownership by looking for least cost solutions such as thin-clients and open source technologies.

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Appendix I: Description of Major Donor Agencies and Their Purpose for Intervention

Agency	Purpose
NORAD (Norwegian Agency for International Development)	Government of Norway's institutional grant support that aims at beefing up Makerere's capacity to effectively cope with both the academic and technological advancements.
SIDA (Swedish International Development Agency)	SIDA's primary rationale is to bridge the digital divide by building ICT capacity for Makerere University staff to facilitate effective research collaboration and research material exchange with colleagues in Swedish and other Universities World-wide.
IDRC (International Development Research Council)	IDRC funded one of the first regional e-mail projects that culminated into the creation of ESAnet in 1991 - a network that was to link computer centres in five (5) African Universities namely Dar es salaam, Makerere, Nairobi, Zambia and Zimbabwe using simple Fidonet-based store-and-forward software.
USAID (United States Agency for International Development)	Through the Leland Initiative, the aim was to enable Makerere's connection to the Internet. This was both in kind and financial terms for procurement of the necessary hardware and software, initial access subscription costs, training and maintenance. USAID also aimed at improving Makerere's library to connect to participate in Electronic Document Delivery Services and Interchange (EDDS/I).
ADB (African Development Bank)	Government of Uganda's Loan from ADB was a continental intervention initiative to bridge the digital divide after realization of the long period it would take some of the developing countries such as Uganda to embrace ICT using limited own resources. The loan facilitated the laying of a high-speed campus-wide fibre optic backbone network to facilitate global networking and to coordinate the strengthening of scientific and teacher education.
Rockefeller Foundation grant and The World Bank	The Rockefeller Foundation grant and The World Bank (matching Learning Innovations Loan) jointly supported institutional capacity building for decentralisation. The purpose is to address the issue of relevance and applicability of skills imparted in higher education institutions and to improve Government service delivery in a decentralized system of governance.
Carnegie Corporation of New York	The key interest for the institutional grant support from The Carnegie Corporation of New York is promotion of Gender equity in access to higher education and involvement in a modernized (ICT-enabled) management and delivery of higher education.

Re-inventing Higher Learning Institutions Communication Media: The case of University of Dar es Salaam Student Information System

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ABSTRACT:

The traditional higher learning institutions communication media in most developing countries remain the notice boards, building walls, and chalk prepared black boards. Higher learning institutions use these traditional media to communicate information from announcements, student nominal rolls, examination results, teaching schedules, memos, and the likes. While it is cheap and does not require any skills to use, limitations of the traditional media hamper higher learning institutions communities. At the end of 1990s, the University of Dar es Salaam has put in place several ICT related projects including the University Student Accommodation System Database. This paper discusses common limitations of traditional communication media and analyzes the potentials of ICT tools adoption in higher learning institutions by presenting the University of Dar es Salaam Student Information System.

Keywords: *Communication Media, ZALONGWA, USAB, USIS, Student Information System*

1.0 INTRODUCTION

When fresher students join the University, they are likely to ask, "*How do I know what is going on in the University?*" the answer to this question seems like, "*Notice Boards, there are absolutely loads of notice boards around the campus supplied by the University. Keep your eye on the ones at the administration block will be updated regularly*". This is a common situation in most higher learning institutions, which enroll thousands of students. Memos, advertisements, and press releases which ranges from public information to personalized information such as examination results, room allocation, and timetable schedules are always published on the notice boards.

Unfortunately, these notice boards can often become quite crowded; hence locating a piece of information on the notice boards can cost the students a lot of time. Notice boards are distributed all over the campus from the students' halls of residence, classroom boards, open spaces, and on the buildings' walls. Usually a piece of information is stamped in a notice board, which is close to the source office. Thus, students need to search the whole campus to locate their related information. For example, if information sought is likely to be released by the administration, then a student need to visit notice boards around the administration block; but if the information is likely to be released by the faculty deans office, then a student has to visit notice boards near to the faculty deans office. In general, there is a chaotic posting of information in most University campuses of which it is not guaranteed whether the intended audience of that information will get it on time.

The University of Dar es Salaam (UDSM) currently serves a population of over 8,000 students. One of its primary objectives has been and continues to be to improve the quality of institutional services. Improving various services at the University including communication and dissemination of information to the community, there is a need to determine how and how well information (especially information related to students) is being managed, communicated, and updated.

This is an empirical study on the advantages and limitations of traditional communication media (the notice boards) at University campuses and impact of usage of ICT tools in assisting storage, processing and retrieval of information at the same time conserving ones security and privacy. Specifically we examined the implementation, use, and the net changes of retrieving student information through the use of specific ICT tools at the University of Dar es Salaam as compared to the way it was while using traditional communication media. This paper is arranged in the following order: Section 2.0 present theoretical perspectives; Section 3.0 present the research methodology adopted; the case study is described in Section 4.0 followed by a detailed discussion in Section 5.0; Section 6.0 is a concluding section followed by a list of references in section 7.0.

2.0 THEORETICAL PERSPECTIVES

2.1 Traditional Communication Media

In this study, we refer to traditional communication media as the place where pieces of papers containing vital information is stamped on the notice boards in order to be accessed by intended audiences. A typical place where the information is posted is on specially designed notice boards, walls of various buildings, and trees in open spaces of University campus.

Traditional communication media are the simplest means of publishing information because when a piece of a paper is stamped on the notice board that is over. Users may visit the notice board on their own convenient time to read the information.

However, the effectiveness of traditional communication media may be questioned, especially at higher learning institutions like the University of Dar es Salaam. First, the University community is very large. It is unlikely that all students will access the same information on the same time. For instance, a press relies is not guaranteed to be accessed to all students on the same time. Many of the students usually do not get the chance of accessing the information stamped on the notice boards before it is removed.

Second limitation of the traditional communication media is on the fact that in order to access a piece of information one has to visit a notice board, therefore no privacy. At the University of Dar es Salaam for example, when the University publishes examination results, room allocation reports, and nominal rolls, some students do not get access to their respective records. When publishing privacy sensitive information of the students such as examination results, the University management hides students' names and display registration numbers and grades only. While the aims of hiding student names is to encode the information from unauthorized notice board users from knowing examination results of a particular student, the resulting effects is that all students has to visit the notice board in order to know their examination results. When the examination result papers get removed from the notice boards, students will start to hunt their results for many days in the offices of their respective lecturer.

Thirdly, traditional communication media is a one-way communication. There is no feedback on to whether the intended audience has received the message. Thus, it is not a guaranteed way if there is immediacy for the information to reach the intended audience.

The last disadvantage of traditional communication media is its volatility. Information posted on the notice boards can be removed any time without notice. For example, one can post a message on examination results and within one hour, the message can be removed to give chances of new important information

However, with its limitations, traditional communication media is there to remain in most higher learning institutions. Traditional communication media is the most convenient way of communication in a large communality. Every one can publish and retrieve information without been taught how to do it.

Electronic communication (ICT applications) is promising to supplement traditional communication media in one way or another. The next section discusses opportunities of the use of electronic communication media.

2.2 Electronic Communication Media

In this paper, the focus is on how electronic communication media can improve the efficacy of information exchanges in higher learning institutions. The availability, scope, functionality, and ease-of-use of electronic communication media are constantly improving with the increasing use of Internet. Such developments have enabled a large range of businesses to adopt, implement, and utilize information and communication technologies replacing traditional communication media. For example, various electronic communication representations (e.g. text, graphics, audio, video, and animation) already have been deeply integrated into the communication practices of most companies.

For those who use computers frequently in their work, the impact of computer-based media on communication with others is increasingly obvious. For these individuals, the computer now mediates a large percentage of their daily interaction, in part because computer media facilitate contacts with people they might not otherwise communicate with or even know of. Foulger (1991) argues that at least among users of IBM's IBMPC computer conferencing facility, computer mediated communication is becoming a dominant mode of interaction, with total use of electronic mail significantly surpassed only by face-to-face interaction.

Early authors, projected computer conferencing as a revolutionary medium of communication, see (Hiltz and Turoff 1978). Turoff's expectation was that computer conferencing will eventually become as commonly used by the general public as the telephone. At least within IBM, both computer conferencing and electronic mail use significantly surpass telephone use. Keisler suggested that, computer conferencing has much in common with past technical innovations, like the telephone and the typewriter, that have had great social impact (Kiesler 1986).

Communication technologies may help diminish some of the difficulties of facilitating the learning process by providing information to students including supplying teaching materials, and teaching schedules (timetable). Educators already recognize that educational uses of technology enhance pedagogy (Laurillard 1987; McComb 1994; Althaus 1997).

The potential for improving student learning process with the use of computer-mediated communication (CMC) is promising. CMC in college instruction potentially facilitates discussion and debate (Shedletsky 1993; McComb 1994), enables collaboration beyond a single physical location or classroom (Lopez and Nagelhout 1995), and offers students opportunities for experiential learning (Bartel 1995; Cohen 1995; Shedletsky 1993b). CMC also may enhance group cohesion among students (Durham 1990), reduce communication anxiety, improve student perceptions of learning (Alavi 1994; Althaus 1997), provide a wide range of information (Benson 1994; Ryan 1994), and extend access to university resources (Acker 1995).

This discussion highlights potential usage of ICT tools on facilitating communications at higher learning environments. However, design and implementation of ICT tools aimed to assist communication in large community, is a complex endeavor because it involves different actors in each process and is a context sensitive process. With these facts in mind, there is a need to highlight theoretical perspective on software development approaches which is now presented in the next section.

2.3 ICT Tools Development Approaches

Successful implementation of an ICT tools (computer Software) in a large organization like the University of Dar es Salaam is to large a extent depending on the approaches used in analysis, design and implementation of the software. In this particular case of communication media at the University of Dar es Salaam, it can be argued that, students and staff directly involved with managing and disseminating information for students are feeling the problem of using notice boards as a more serious issue than higher level staff in the hierarchy of the University administration. Thus convincing the University Management to invest a substantial amount of money for developing an appropriate ICT tools seems to be difficult. Also at the time of implementing this ICT tool at the University, there had been very few analog examples in the country of such a tool (University of Dar es Salaam is the largest and oldest university in Tanzania). These two facts that there is no funds set aside for implementing ICT tool to assist managing and disseminating information; and that there was uncertain requirements analysis of the ICT tool to be developed, led to the selection of **Open Source Software** development approach which is now described:

Open-source software (OSS) is software for which the source code is distributed or accessible via the Internet without charge or limitations on modifications and future distribution by third parties (OpenSource 1997). It is a phenomenon that grew slowly out of the BSD Unix and Free Software Foundation GNU projects during the 1980's, but it was not until the 1990's that the open-source software development truly gained momentum.

Explaining Open Source software engineering tools, (Robbins 2003) argues that, Open Source Software Projects are characterized by the following features: (1)tools and communities which provide universal, immediate access to all project artifacts (especially the program source codes); (2) Staff projects with motivated volunteers; (3) System design which follows standards to validate the project, scope decision making, and enable reuse; (4) system design which practices reuse and reusability to manage project scope; (5) System development which support diversity of usage and encourage plurality of authorship; (6) project planning and execution is encouraging early and often releases; and (7) project execution place peer review in the critical path where feedback from users and developers is one of the practices most central to the open source methods (Robbins 2003).

In this case, developing an ICT tool for higher learning institutions which touches every member of the institution's community, open source development approach seems to be a suitable approach which will give a possibility of allowing different system stakeholders to participates in one way or another, in the system development. Another justification for adopting Open Source development approach is the heterogeneity of ICT infrastructures existing at the University. The university has different computer systems running MS Windows, Linux, and OS Operating System (Macintosh computers). Developing a cross cutting system which will cater for all these system brought a challenges which could to some extent be solved by adopting Opens Source Software such as MySQL Database Management System, Java, and PHP. Thus, in this case OSS is an appropriate software development approach in that it will allow the use of free software, free contributions from software developers, and full involvements of the system users.

Typically, software engineers try to separate the system into distinct areas of functionality. Client/server applications usually implement what is referred to as Three Tier Architecture. This architecture divides the application into a presentation layer, a business layer, and a data/data access layer, each of which can be replaced without causing or requiring a lot of redesign to the other layers. Client/Server architecture of a web based application which is deployed through the internet is presented in Figure 1.

3.0 RESEARCH METHODOLOGY

This study follows under "Action Research Paradigm". Action research has been typified as a way to build theory, knowledge, and practical action by engagement with the world in the context of practice itself (see, e.g. Kock 1997; Whyte *et al.* 1991). Dick (2002, p.1) explains an action research as a research approach, which has the dual aims of action and research:

- action to bring about change in some community or organisation or program;
- research to increase understanding on the part of the researcher or the client, or both.

In this study, five phases of action research approach are adopted, as Baskerville and Wood-Harper (2002, p.133) argue that, "the most prevalent description of action research details a five phase, cyclical process which can be described as an 'ideal' exemplar of the original formulation of action research". This ideal approach first requires the establishment of a 'client-system infrastructure' or research environment. Then, five identifiable phases are iterative: (1) diagnosis, (2) action planning, (3) action taking, (4) evaluating, and (5) specifying learning. The key assumptions of action research are that "social settings cannot be reduced for studying and that action brings understanding" (Baskerville 1999, p.7). In our particular case, the client system infrastructure is the University Accommodation and Examination Records Systems. The five phases are now described:

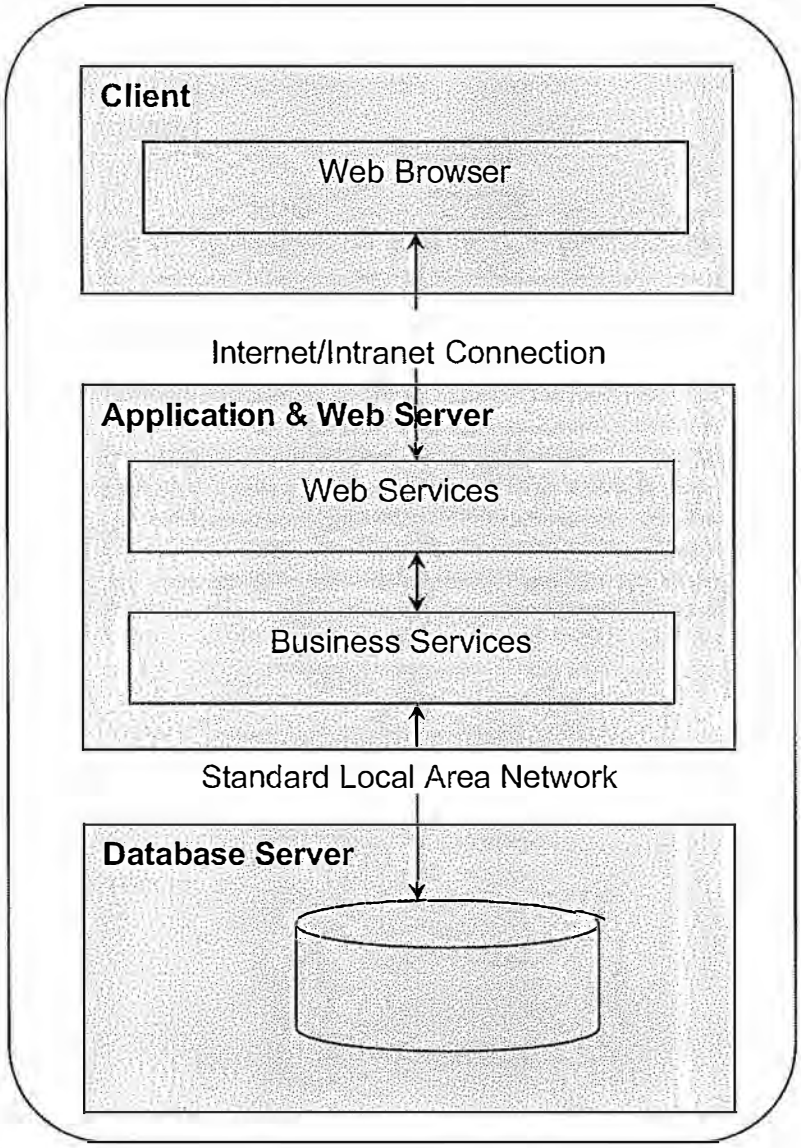

Figure 1: Web Application Architecture

Diagnosing: Baskerville and Wood-Harper (2002, p.134) describes diagnosing phase as it "corresponds to the identification of the primary problems that are the underlying causes of the organization's desire for change". According to Baskerville and Wood-Harper, diagnosing involves self-interpretation of the complex organizational problem to develop certain theoretical assumptions about the nature of the organization and its problem domain. In our case we wanted to solve the problem of communication media where some vital information should go online through the use of ICT tools. We then developed a theory that a web based ICT tool will enhance smooth publication, dissemination and access of vital information to both students and staff of the University.

Action Planning: After the diagnosing phase, researchers and practitioners then collaborate in the next activity, action planning. The discovery of the planned actions is guided by the theoretical framework, which indicates both some desired future state for the organization, and the changes that would achieve such a state. The plan establishes the target for change and the approach to change. As we have seen through theoretical perspectives that Open Source Software is a suitable approach, we planned to develop the ICT tool using Open Source Software called MySQL database System

that will run on Linux (Fedora), the business logic of the system is implemented using PHP and Java scripts. However, some data intensive activities had to be processed by desktop application developed using MS Visual basic. It is further planned that, the system has to use both intranet and internet in order to enable community members to access information outside the University campus using internet which will somehow be slow but when they are in the campus.

Action Taking: This phase implements the planned action. The researchers and practitioners collaborate in the active intervention into the client organization, causing certain changes to be made. In this particular case, we developed the system as a combination of six modules namely: (1) Nominal Roll – which keeps students biographic data; (2) Accommodation – which keeps information about students halls of residents and student room allocation; (3) Academic – which keeps academic related information including examination results; (4) Accounting - for payments managements; (5) Student Information – which combine different information from other modules that is relevant and personalized to each student and (6) Database Maintenance – which enable system administrator to manage users of the system including granting and revoking user rights. The system was developed as a three tier database system where the database tier was implemented using a MySQL Database, the business logic tier was implemented using a PHP and Java programming scripts, and the client tier was implemented as a HTML web pages. The system is installed as a simplified distributed database system architecture where the database and the business logic systems are located in different geographical sites as presented in Figure 2.

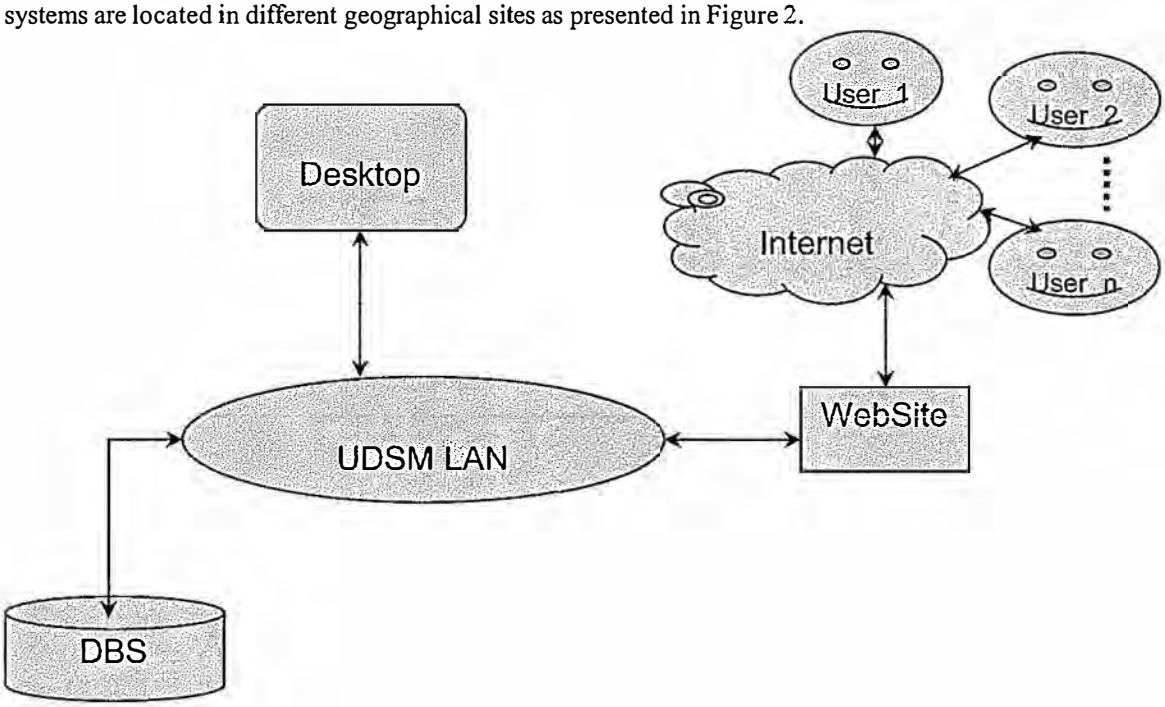

Figure 2: UDSM Student Information System Installation Architecture

In Figure 1, the database is located at the Faculty of Science, Desktop application is located at the Department of Computer Science and at the University Student Accommodation Bureau, WebSite is located at University Computing Centre and users are connecting to the database everywhere through Internet.

Evaluating: After the actions are completed, collaborating researchers and practitioners evaluate the outcomes. Evaluation includes determining whether the theorized effects of the action were realized, and whether the effects relieved the problem. In this system, evaluation was done in two approaches: (1) to evaluate whether the university community is using the system or not. This was done through logging system use. The system has a feature which records every user who logs in and records every page a user has accessed. With this, it is possible to log how many web hits have been

performed per day. (2) Evaluation was made through the flexibility of the system on presenting user information. This was achieved through logging user comments to the system designer and through directive based information. For example, if room allocation reports are published on the website, we observed students to get knowledge of their respective room allocated and to see if they will go to the right rooms.

Specifying Learning: According to Baskerville, knowledge gained in the action research (whether the action was successful or unsuccessful) can be directed to three audiences First, restructuring of organizational norms to reflect the new knowledge gained by the organization during the research. Second, where the change was unsuccessful, the additional knowledge may provide foundations for diagnosing in preparation for further action research interventions. Finally, the success or failure of the theoretical framework provides important knowledge to the scientific community for dealing with future research settings (Baskerville, 1999 p.14). This paper is aimed to specifying learning where it tells which has worked well, which part did not work and provide future development recommendations.

Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science through joint collaboration within a mutually acceptable ethical framework. The ideal domain of action research is therefore revealed in three distinct characteristics (Baskerville and Wood-Harper 2002 p.136) of the approach: The researcher is actively involved, with expected benefits for both researcher and the research client. The knowledge obtained could be immediately applied. The research is a cyclical process linking theory and practice. Inline with this action research practices, the author of this paper has played three roles: first, he was the principal programmer of the system where he coordinated all analysis, design and implementation activities of the project. Second, he was a researcher where he wanted to see how we can use theoretical perspectives from research publications to implement a system of this nature. Finally, he was a system user where as a University Lecturer and Departmental Examination Officer, he wanted to publish examination results and get feedback on human errors made while processing examination results and that he wanted to enable university students to access their examination results where ever they are. This justifies the appropriateness of regarding this three years work (2001 till 2004) as an action research study.

4.0 CASE DESCRIPTION

The University Student Accommodation Bureau (USAB) is a unit of the University of Dar es Salaam with primary task of running the University Student Hostel and Halls of Residence. The University of Dar es Salaam has the following student hostels and halls of residence (capacity in bracket): Hall one, Hall two, Hall three, Hall four, Hall five, Hall six, Hall seven, Kijitonyama hostel, Ubungo Hostel, UCLASS, and Mabibo hostel. Mabibo, Kijitonyama and Ubungo hostels are located outside the University of Dar es Salaam main campus. Each student been accommodated in the halls of residence has to pay caution fee.

For long time, USAB has been using manual (paper based) information system. One of the ineffective operations of the manual system is to allocate one student to more than one room (double allocation). As a result many students lack accommodation rooms while some students get more than one room, a situation that was creating a hostile situation at the University.

In 1999, USAB engaged in a contract for developing a computer database in order to computerize its manual information system. USAB requested the service of the contractor to prepare student accommodation database, which will keep records of Halls of students residence, and records of students accommodated on the Halls of residence. It was stipulated on that contract that the USAB database would be able to register

"name of student i.e. surname, first and second names; student registration number; programme in which student is enrolled; year of study; number of years at the university to date; name of sponsor;

hall or hostel of residence; block number if there is any; room number; single or double room especially for hostels; rental fees; rental fees paid; rental fees carried forward from previous year; unpaid rental fees for present academic year; property damaged; penalty due to property damage; other penalties; grand total unpaid dues and fees; deposit paid by the student pear year, total amount paid for all students, and examination results" (Lungo 2004, p.2).

The USAB database was designed and the first version was released in March 2000. After successful testing and validation phases, the USAB computer database known as ZALONGWA started to be used in July 2000 during the room allocation exercise of the academic year 2001/2002. The first version of ZALONGWA software was designed as stand alone software where the software was installed in one machine (computer) and has the following functionalities: nominal roll; room reservations; room allocation; room rental charges and caution fee; printing identity cards; mail labels; and examination records.

Nominal Rolls: The USAB software keeps an up to date electronic database of all students at the University. The student nominal rolls are imported as they are from the University Admission Office. Users then can retrieve nominal rolls sorted in study programmes, and or years of registrations. With database record operations like "Add", "Delete", "Save" and "Find" records, the software allow smooth maintenance of the nominal roll.

Room Reservations: The University has set criteria to prioritize students who should be accommodated first in the halls of residence. The problem is to group Room applicants into these criteria. The database registers all applications, and gives smart reports based on predefined Room allocation Criteria.

Room Allocation: Accommodating many people needs well-informed system to know who is living in each room at any time. If a room can take more than one person, the USAB need to know when a room is full or has a vacant bed. The software has proved to solve this problem, as this is the main function of the system.

Room Rental Charges and Caution Fees: The software has an in-built billing system that keeps tracker of all individual tenants payments records and generates individual or grouped financial payment reports. "Caution Fee and Penalty charges" for each student are taken care too.

Identity Cards: The USAB database not only registers students and keep nominal roll database up to date but also can print student identity cards based on the same registered information of the students. In the academic year 2001/2002 and 2002/2003 the University Admission Office has used this function to print student identity cards for all students joined the University in those academic years

Mail Merge and Mailing Labels: Since the database registers addresses of all students, when one need to send them mails, the system can print mail labels for all addresses of the people registered in the system at once. The software also has a mail merge function, which allows one to compose one mail and send to all registered people.

Examination Records: The software registers all examination records and print Transcripts/certificates for graduate and continuous assessment of students. Main academic reports includes: course registration and class size reports, course work and examination results,

examination transcripts and continues assessments of students. Thus it creates a common database of all examination records at the institute instead of having every lecturer to keep his/her own student examination records.

While using the stand alone version of ZALONGWA software, after the room allocation exercise is over, reports were printed and then stamped on the "notice boards" for the students to know their respective rooms allocated. As USAB expands to off-campus hostels such as Mabibo, Ubungo, and Kijitonyama hostels, the need of re-designing ZALONGWA database arises. ZALONGWA database was re-designed to use Internet Web enabled user interface so that users (hostel wardens) at the off-campus hostels can access the database and update the database if required. Smart reports were also designed specifically for students, and USAB staff.

At the time of writing, the Internet based ZALONGWA Database version available from http://www.udsm.ac.tz/usab/index.html has four types of user categories namely students, lecturer, housing officer, and database administrator. Users are required to create accounts in ZALONGWA database in order to get username and passwords. When a user logs on the system, first he/she is validated to see if has supplied known login identities (username and password), if successful login the system determines the user category in order to be presented the corresponding menus in that category. While lecturer and accommodation officer can view many records of student they are dealing with, students can view information related to them. For example, when a student logs on the system and click "examination results" menu, a report that has records of him/her will be displayed.

5.0 DISCUSSION

This particular case of re-inventing higher learning institutions communication media in developing countries draws four different discussion topics: the role of open source software development approach; the design of the system architecture; impacts of usage of the system toward access and dissemination of information; and the limitations of the system which are now explained.

5.1 The role of Open Source Software Development Approach

Referring the theoretical section of the paper, it was argued that, when it comes to higher learning institutions in developing countries, information publication and retrieval is a business of students and staff in the low levels of the administration hierarchy. Staff in the upper levels of the administration hierarchy always provide orders to others to publish and retrieve information (usually on notice boards). Thus, it is unlikely that high ranked staff will make a substantial budget for developing an ICT tool to assist in publishing and retrieving information. In this case, open source was useful approach since we had no budget for procuring database, compiler and operating system software and that we relied on existing computer hardware and network resources.

The developer of this system is a university academic staff employee. After delivering the system and impressing the university management that the system is useful at the University, he was paid as an honoraria. Another important issue regarding the use of open source is on its cross cutting operation on different platforms. The university has different computer systems but the system was able to be accessed through all heterogeneous systems like Windows, Macintosh and Linux systems at different departments. We therefore argue that, the use for web based application enhanced with the free software of Java and PHP is an appropriate approach.

In this particular case, while the principal programmer knows the system, he was also having other duties including teaching, student supervision and examination records processing. Thus, he had

very limited time to work on actual programming of the system. The approach of using Open Source Software development allowed other hackers to contribute in the project with valuable pieces of codes. Since project contributors were unpaid programmers who contributed based on their interest, again open source approach enabled the possibility of implementing this system with minimum costs yet delivering a high quality product. Early versions of the system were critically criticized by the university students. However, as the principal programmers knew that Open Source approach starts with vague versions of the system, those critics were regarded as constructive comments which enabled reshaping the project.

5.2 System Architecture

Installation architecture of this University Student Information System enabled different stakeholders to work with the system as if they were alone. The System imports students' admission nominal roll (name, registration numbers, degree program, etc.) from admission office. At the USAB office, staff uses the names and registration numbers of the students in the database to enter room allocation reports. At departments lecturers use the system to enter examination results. USAB staff can only access information about room allocation and lecturers can only access information about student examination results. However, students get integrated information on their rooms allocated and examination results. Thus, instead of hunting this vital information on the notice boards, students get all information personalized to them in one button click (no student can access information of other students), see Figure 3. The use of three tier web based architecture enabled the database to be located to different geographical place with its desktop and web based business logic tier.

5.3 Impacts of the System

The system is regarded as a liberation tool because during the manual system, student for example, had to hunt information on various notice boards. A notable problem solved by this system is the publication of room allocation reports. Before this system, USAB was printing more than one hundred pages as room allocation reports. Those reports were then posted on various notice boards, thus a student had to search his/her room all over the campus. If it happens that some pages get removed from the notice boards, all students had to queue in front of USAB office in order to locate their rooms of residence. Not only this was creating a hostile situation during the start of every academic year but also was not ethical since information about student room allocation was regarded as security and private sensitive information. This system has solved this problem completely where each student get his/her personal information online. Examination results are still posted on the notice boards, however, some departments has started to publish examination results using the system. A lot of complaints are now submitted by students where they demand all examination results to be published using the system because not only it is too disturbing to came to the campus during holidays in order to search their examination results on the notice boards but also it is regarded as unfair to publish somebody's examination results on public notice boards.

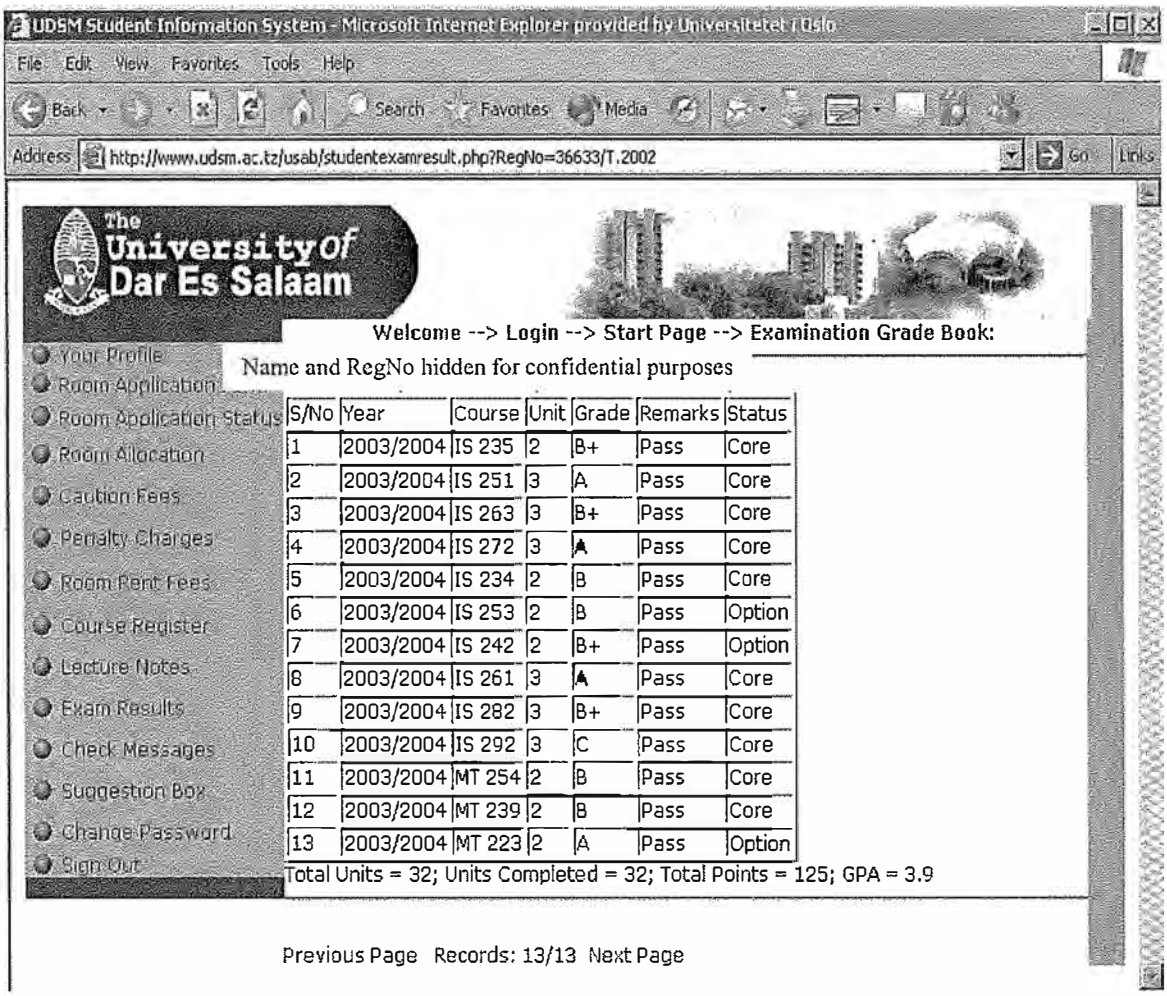

Figure 3: Student Menus When Logged on the UDSM Student Information System

USAB staff enjoy the system in that it relief them from long queues of students hunting their room allocation; cross checking double allocation rooms and students; room rents and caution fee student balance calculation and communicating with students since students use the system to send them general queries. Examination Officers who use the system have benefited from examination records compilation, progress reports generation and prompt communication with students where students can send any queries based on their examination results. The system also allows students to register courses online – a process which enables lecturers to know exactly the size of the classes. If the system will put in its full operation, will to a large extent relief students from hunting information to every corner of the University.

5.4 Limitations and Challenges of the System

Information System are always regarded as social systems (Braa and Hedberg 2002). Thus, while developing information system whether a paper based system or a computer based system, technical and political or social factors are there to compromise usage and operation of the system. This system has demonstrated to perform satisfactory on the technical side; however, some users are just feeling uncomfortable to work with the system. For example, while USAB is accepting online room applications through this system, some students prefer to submit paper based room application forms which will be entered to the system in order to sort the applicants in different room allocation criteria. Although examination officers prefer to receive examination results through this system where lecturers are presented with a web based form to enter examination results for their courses,

still many lecturers prefer to submit their examination results using spreadsheets or sometime hand written hardcopies. The challenge now is to motivate university community members to use the system extensively.

In developing countries like Tanzania there are serious network problems. The network is of low bandwidth with frequent power failures. Since the system is relying on availability of the Internet then it is limited in that sometime the network is not available.

6.0 CONCLUDING REMARKS

In this paper we analyzed limitations of traditional communication in communicating vital information such as examination results and room allocation reports at higher learning institutions using the University of Dar es Salaam as a case study. We have further explored opportunities of electronic communication media in higher learning institutions by discussing online web based database system using open source approach. This system has improved information publication, dissemination and communication between students and staff of the University.

Currently the use of ZALONGWA database is extensively in room allocation information system, although it can be used for publishing examination results and lecturer notes as an e-learning software. However, it can be argued that the experience gained from publishing room allocation reports on the notice boards to the Internet, and due to the fact that student information is personalized to the extent that no one can access someone room allocation reports in a simple way as when using notice boards is a commendable job to learn. ZALONGWA database has gained credibility and is one of the most popular software known at the University.

The study did not explore cost implications while implementing electronic communication media, but we are arguing that, many institutions runs stand alone databases which store vast amounts of data especially student records. It is therefore recommended that it is high time for higher learning institutions to deploy Internet based applications in order to facilitate accessibility of resources and communications in their communities. Traditional communication media is there to remain, however this case study draw attention of re-thinking the tendency of publishing personal record data on the notice boards.

We further conclude that, Open Source Software development approach is appropriate where there is a shortage of resources including funds to buy proprietary software and to hire dedicated programmers. Open Source Software engineering tools enable the system to be tested early by the intended users.

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SESSION A5: RESEARCH-IN-PROGRESS PAPERS

ICTs and Capacity Building through Apprenticeship and Participatory Methods Applied to an ICT-based agricultural water management system

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ABSTRACT:
This paper describes the COMMON-Sense Net project, a research in progress and joint development between the Swiss Federal Institute of Technology, Lausanne (EPFL) and the Indian Institute of Science (IISc) in Bangalore. The project concerns the design and implementation of an Information and Communication Technologies (ICT) system for agricultural management in a rural community of Karnataka (Southern India). It is unusual in the sense that it focuses on Environment-to-Person Information Systems (EPISs) rather than on Person-to-Person Information Systems (PPISs). Beyond its mere engineering value, we analyze the potential that such a project can unleash for ICT capacity building in the local context of the village. In particular, we study the correspondence between capacity building and knowledge creation, and we describe how a design science approach can foster this kind of capacity building if it is integrated in the project methodology in an iterative and participatory way.

INTRODUCTION

In this paper we describe a research in progress in the area of Information and Communication Technologies (ICTs) for development and outline a framework to study the project's impact on ICT capacity creation. COMMON-Sense Net (an acronym that stands for Community-Oriented Management and Monitoring Of Natural resources through a Sensor Network) is an ICT-based agricultural water management system to be deployed in a semi-arid region of Karnataka, India. Traditionally, such a project would be executed as a rather isolated engineering project focusing on its contribution to the improvement of rural water management. However, we believe that the consistent incorporation and analysis of the social environment can bring the additional benefit of helping the rural community to integrate into the Information Society by assimilating new ICT capacities. Thus, this paper focuses on the following research question:

Can an ICT engineering project contribute to building local ICT capacities for the Information Society in a developing country context? How can it achieve this?

We address this question by applying a set of theoretical concepts to the COMMON Sense Net project. We particularly look at human capacity building through participation as a form of ICT education in ICT for development projects. We believe that rural communities and developing regions ask for innovative methods that go beyond traditional classroom learning. Therefore we outline three categories of ICT capacities, introduce a process of knowledge and capacity creation, study apprenticeship as a form of knowledge and capacity appropriation and analyze it all in the execution of the COMMON Sense Net project.

The choice of India as a test-bed may be questioned by some, since this country is today widely recognized as one where information and communication technologies are booming at the fastest rate. As a matter of

fact, teledensity has exploded from 2% to 7% between 1999 and 2003 and is foreseen to increase to 20% in the next five years (UK Trade and Investment 2003). On the other end, rural connectivity remains for the time being extremely low at just over 1%. Today, more than 970 million Indians do not have access to a telephone. Fortunately, there are several initiatives currently undertaken to reduce this gap and increase rural density by deploying GSM networks and wireless local loops (i.e. local wireless networks connected to the wired telephone network via an access point). The n-Logue project is in that regard exemplary (Prahalad and Hammond 2002). However, India remains, with its mix of high technology and rural underdevelopment, a paradigmatic case for the digital divide and an ideal field for a development project involving the use of ICTs.

The paper is structured as follows. In the next section we introduce the COMMON-Sense Net project for agricultural water management. This undertaking, which is partially financed by the Swiss Agency for Development and Cooperation (SDC), is a joint project between the Swiss Federal Institute of Technology, Lausanne (EPFL) and the Indian Institute of Science (IISc). In the following section we argue that capacity building is central to the development of an information society and has three basic axes: infrastructure, applications & content, and usage. We ask ourselves how COMMON-Sense Net can help fostering these three capacities throughout the research in progress. We therefore introduce a model of dynamic knowledge creation (Nonaka, Toyama et al. 2000) in order to conceptualize capacity building as a form of knowledge. We then apply the concept to COMMON Sense Net. Afterwards we outline how dynamic knowledge creation can be instrumentalized in rural communities of developing countries, namely through apprenticeship and participatory methods. In the following section we review design science as a methodology to build and evaluate the agricultural water management system. Finally, we draw conclusions and introduce future work on the subject.

COMMON SENSE NET

Several authors have discussed the formidable potential of ICTs to foster development in the South (Heeks et al., 2002; Negroponte, 1998; Walsham, 2001; Westrup et al., 2000). They show that ICTs can be applied to a wide spectrum of different areas to leverage development projects.

Current literature on ICT for development is so abundant that the term itself has become a common phrase for the civil society, as was illustrated by the recent World Summit on the Information Society and its major event, the ICT for Development Platform. However, we believe that this literature is still ignoring an important facet of information technologies by focusing on *Person-to-Person Information Systems* (PPISs) only. These are systems that either connect people among each other, that connect people with machines that store knowledge created by people, or that connect machines that exchange this knowledge. In contrast, in this paper we address the value and the issues of another important area of ICT for development that in our opinion is still rather poorly researched: *Environment-to-Person Information Systems* (EPISs). These are systems that collect environmental information and communicate them to machines and people. With the goal to improve living conditions, this sub-area of ICTs helps individuals and communities develop a better knowledge of the physical parameters that make up their environment (e.g. pollution monitoring, agricultural management, etc.). We argue that development projects that focus on designing and building the tools for collecting and disclosing environmental information have a direct impact through the artifacts they build, but can also have an indirect impact through the ICT capacities they create via dynamic knowledge generation. We will analyze this hypothesis in the COMMON-Sense Net project for ICT-based agricultural water management in rural India, which we introduce in the following lines.

The problem of agricultural water management is today widely recognized as a major challenge that is often linked with development issues (World Health Organization, 2003; Food and Agriculture Organization (FAO), 2001; FAO Agriculture Department, 2002). In the semi-arid areas of developing countries, marginal farmers and small farmers (with a land holding between 2 and 4 hectares) cannot afford to pay for powered irrigation. Neither can they protect their cultures against pests and diseases by spraying their fields with costly chemicals. Thus, they heavily depend on the unpredictability of climate.

Based on a study conducted for over a decade in the semi-arid region of Pavagada in Karnataka, India (Rao and Gadgil, 1999), it is by now recognized that reliable local metrological data and knowledge of soil moisture and ground water conditions can significantly improve agricultural management.

From an engineering point-of-view, sensors are a relevant answer to that challenge. However, a stand-alone sensor, due to its limited range, can only monitor a small portion of its environment. Because ground and crop conditions can change significantly over space and time, the use of several ICT-based sensors working in a network seems particularly appropriate.

The COMMON-Sense Net project aims at designing and developing an integrated network of ICT-based sensors for agricultural management in the semi-arid rural areas of developing countries. In addition of having an effect on yield and efficiency at the local level, the system should allow for the collection of extensive data that can be also used to better understand the effects of water - and possibly other environmental parameters - on agriculture, and thus to develop replicable strategies.

COMMON-Sense Net consists of a wireless network of ground-sensors that record periodically the state (salinity, humidity, etc.) of the soil, while subterranean sensors monitor the level and quality of ground-water. Sensors record data on a periodic basis and send them in a multi-hop fashion (meaning that every node is at the same time a data-collection, a transmission and possibly a relaying unit) to a centralized processing unit, which correlates them with external data and models in order to assess the optimal management strategy (be it for cropping, chemical treatment or irrigation). The centralized processing unit can be linked to external meteorological servers to get the global data useful for its computations. This can be done, depending on the environment, through a wired or wireless connection, or a satellite link.

Self-organized networks (also called ad-hoc networks) are communication networks that do not need any other infrastructure than the communicating devices themselves to operate. With such a paradigm, two or more devices may at any time create a local communication network, a device may seamlessly integrate or quit an existing network, a node may serve as communication relays for other nodes, all this without the need of any fixed infrastructure or the intervention of a central authority. In our case, the benefits of using a self-organized wireless network of sensors lies in the ease of deployment (sensors can be added, removed or moved around without having to reconfigure the whole network) and the resilience of the network against nodes failures.

Such a project seems at first sight to be merely about artifact building. However, in order to be successful, it must insure its own sustainability, and develop skills adapted to an information society.

CAPACITY BUILDING FOR THE INFORMATION SOCIETY

We define capacity as the potential for an individual to develop skills that are instrumental to his or her development (be it educational, social, economical etc.). In this section we outline a simple framework categorizing ICT capacities for the Information Society (Osterwalder 2004) in order to define in what areas the COMMON-Sense Net project could influence the stakeholders' existing ICT capacities. Subsequently we introduce an adapted conceptualization of the knowledge creation process (Nonaka, Toyama et al. 2000) in order to understand and analyze the capacity creation process in the project's context.

Human Capacity for the Information Society

Kaplan (2001) defines the information society as a society where the ability to access, search, use, create and exchange information is the key for individual and collective well-being. Accordingly, Osterwalder (2004) proposes a list of the resources and the related human capacities that are essential for the development of an information society (cf. Figure 1). The resources are threefold. First, there has to exist an ICT infrastructure in terms of hardware, access and software. Second, locally relevant applications must be available. Third, a widespread ICT user base should exist. In order to provide these resources an Information Society must develop three main human capacities. First, it has to build the capacity to provide

and maintain infrastructure at a reasonable price. Second, it has to build the capacity to create and maintain useful local applications and content. Third, it has to build the capacity to understand and use applications.

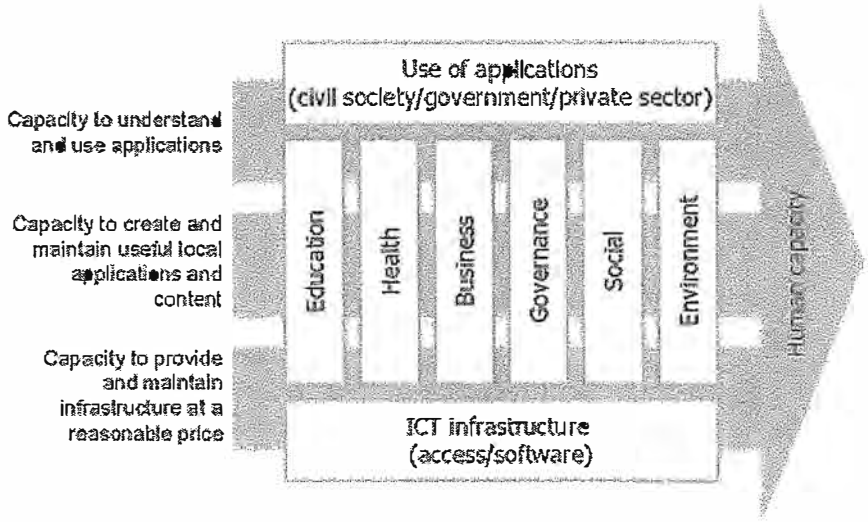

Figure 1: Human Capacity for the Information Society

As regards the COMMON Sense Net project and the described capacities we can ask ourselves the following three questions (Q1, Q2, Q3):

Q1) To what extent does the project help developing an ICT infrastructure for farmers in terms of developing capacities to provide and maintain an ICT infrastructure for water management?

Expected observations: The sensors are supposed to be self-maintaining and can be moved around without configuration work. Local stakeholders should be able to use them with little prerequisites. However, as users will not develop any specific capacity in that domain, failing nodes will constitute a particular challenge. An engineer will still be necessary for reparation. Therefore, special attention must be given to the search of a specific model to foster community involvement and minimize outside specialist intervention.

As regards the front-end of the system local stakeholders will be involved and trained in order to take care of it. This front-end will be based on community premises (the school for instance) in order to familiarize people with computers and their use. The possible defection of people operating the system must also be taken into account, as they may leave for a better position as soon as they learned new computing skills. Using people actively involved in the community, such as school teachers, could moderate this risk. Finally, the involvement of children into the project should be considered to expose them to and familiarize them with modern information technology.

Q2) To what extent does the project help develop locally relevant ICT-based agricultural water management applications, notably in terms of developing capacities to create and maintain these applications?

Expected observations: The development of skills to create and offer locally relevant ICT applications is particularly important. One of the fundaments of our approach is to develop the agricultural water management system based on community involvement.
We hope that this effort unleashes capacities to combine the locally existing knowledge and experience with the enabling forces of technology. Of course, this approach demands facilitator capacities from the engineers who have to mediate between tradition and change. We believe that the major challenge lies in the development of a sense of ownership of the local stakeholders in the applications. Hopefully, ownership will lead them to improve and maintain the water management system.

Q3) To what extent does the project help the farmers develop their capacities to understand and use the ICT-based water management systems? Is there a spill-over in terms of developing more general ICT-usage capacities?

Expected observations: This project will expose local stakeholders to new models for their agricultural environment. This will have an impact on the decision process for crop selection, cropping patterns, pest management etc. More generally, the possible impact ICT can have on their daily life will be presented in an integrative rather than disruptive way (using new information sources to accomplish more efficiently usual tasks). We will also evaluate to what extent the access to the water management system as a central and indispensable application will encourage the development of more general computer literacy skills.

In order to observe and further analyze the process of capacity building throughout the COMMON Sense Net project we use the conceptualization of knowledge creation provided by Nonaka, Toyama et al. (2000). We understand capacity building in the three areas described above as a form of knowledge creation as described in the model by Nonaka, Toyama et al. (2000). They explain the dynamic process of contextualizing and processing information in a way that allows generating value as well as new knowledge and capacities.

Knowledge creation, context and knowledge assets

Nonaka, Toyama et al. (2000) outline four elements in the process of knowledge creation: The knowledge creation cycle, a shared context for knowledge creation and the circulating knowledge assets.

The first element of knowledge creation, which Nonaka, Toyama et al. (2000) call SECI (acronym for Socialization, Externalization, Combination, Internalization), functions like a spiral describing the interactions between actors in order to transmit knowledge in it tacit or explicit form, and the actions of individuals or groups in order to translate knowledge from tacit to explicit, and vice-versa. This process follows four modes feeding each-other in a spiral (Figure 2). First, the socialization process of transmitting and converting new tacit knowledge through shared experiences. Socialization typically occurs in a traditional apprenticeship. Second, the externalization process of articulating tacit knowledge into explicit knowledge. The success of such a conversion depends on the sequential use of metaphor, analogy and model. Third, the combination process of converting explicit knowledge into more complex and systematic sets of explicit knowledge. Finally, the internalization process of embodying explicit knowledge into tacit knowledge.

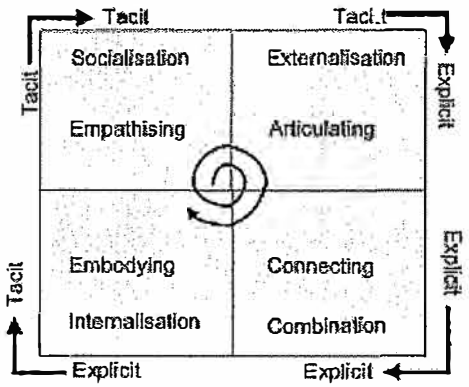

Figure 2: Knowledge creation cycle (Nonaka, Toyama et al. 2000)

In the COMMON Sense Net we aim at analyzing these four phases with regard to capacity building. The first phase of socialization concerns discussions between farmers to emphasize their desires and aspirations regarding agricultural water management. The second phase of articulating their desires concerns discussions between farmers and technical specialists. The third phase of combining knowledge concerns the connection of the aspirations of the farmers with technical knowledge in rural engineering, water

management and ICT in order to design a system. The fourth phase consists of applying the system with farmers and specialist. The loop starts over with phase one.

The second element of knowledge creation that Nonaka, Toyama et al. (2000) mention is the context, which they call *ba*. This is particularly interesting for the case of ICT for development projects such as COMMON Sense Net. It is often stressed that the particularities of the developing country context (stakeholders and environment) and technology development are highly dependent (Biggs and Smith 1998). The COMMON Sense Net project covers a wide diversity of contexts, which must be carefully considered during the execution of the project and the analysis of the ICT capacities. Among several other diverse contexts most importantly figure the involved rural Indian village, the laboratory at EPFL in Switzerland and the laboratory at IISc in Bangalore.

The last element of knowledge creation that Nonaka, Toyama et al. (2000) mention are the knowledge assets. Knowledge assets are the inputs, outputs and moderating factors of the knowledge-creating process. Those assets are experiential (e.g. skills, know-how...), conceptual (e.g. concepts, designs, methods...), systemic (technological platforms, manuals, libraries of software components...) and routine-based (e.g. organizational routines). All these assets need to be 'mapped' in order to be usable. This mapping process is at the core of the dynamic knowledge creation. In the COMMON Sense Net project we particularly aim at observing the interaction between the tradition skills and know-how of the farmers in terms of agricultural water management and the modern concepts and ICT systems brought in through the project. We seek to analyze how this interaction creates new knowledge assets with reference to ICT capacities for the Information Society.

APPRENTICESHIP & PARTICIPATORY METHODS TO DEVELOP ICT CAPACITIES

In the previous sections we presented the three axes along which capacities are built for creating an Information Society and argued that analyzing the knowledge creation process was central to understanding capacity building. In this section we study apprenticeship as the main mechanism through which we believe ICT knowledge and capacity will be created in the COMMON Sense Net project.

We define apprenticeship as a situation in which a learner works intensively with an expert to learn a new task that may necessitate the understanding of new concepts. We present it as an alternative to traditional classroom learning that can be very effective to instrumentalize knowledge as capacity in rural communities of developing regions. Particularly for Environment-to-Person Information Systems a participatory approach seems an appropriate tool that can help overcome some underlying barriers to the development of innovative environmental technologies (Fleming and Henkel 2001; Sotoudeh 2003). The question is how much of a spill-over effect participatory learning can have on the development of more general ICT capacities.

Misperceptions, what Heeks 2001 calls design-actuality gaps, namely the gap between the technocrats who design systems using scientific knowledge and the local context characterized by "irrational" cultural features, seem to be at the root of most failures for Information Systems in developing countries. This recurring flaw calls for the concept of participative design and implementation.

In participative approaches, the end-user is constantly involved in the design and assessment of the product or service being developed for him. Cooper (2000) emphasizes the role that group working and end-user involvement can play in a successful implementation. However, Heeks (2001) warns that this is no guarantee to success in developing countries, since these techniques have usually been developed in and for industrialized countries organizations. A lesson to be drawn is that a participative approach in a developing country is instrumental to success if and only if it integrates a tool to bridge the contextual gap between design and use.

We claim that the resort to apprenticeship is such a tool. Freeman's (1997) definition of apprenticeship is "learning by doing". Adapting this definition to our context and trying to be more specific, we consider apprenticeship as the process by which a person acquires a new knowledge or skill by imitation and

interaction with someone who possesses that skill or knowledge already, rather than in a formal way in the classroom with a teacher. What is interesting is that the apprenticeship process matches quite exactly the way indigenous knowledge is acquired (WorldBank, 1998). This particular feature of apprenticeship means that it is much less disruptive than other forms of education as far as radically new forms of knowledge are concerned. In particular, if one looks at the main features of indigenous knowledge as summarized by the World Bank (1998), one can identify where the potential of apprenticeship lies:

- tacit knowledge: apprenticeship is based on the tacit experience of watching someone doing something, without necessarily verbalizing the knowledge or skill presented.
- transmitted in a non-written form: apprenticeship is a transmission process based on interpersonal interaction rather than in books.
- experiential rather than theoretical knowledge: apprenticeship is learning by watching and doing, thus experiencing rather than studying.
- learned through repetition: apprenticeship is learning by imitating.
- constantly changing: learning process adapts to changing circumstances.

Our hypothesis is that there are some aspects of apprenticeship that make it particularly suited in the acquisition and integration of radically new paradigms of knowledge. It is a self-organized process in which every individual takes ownership of the knowledge he or she is acquiring. Not relying on formal teaching, it can be more integrated in the social structure and possibly more equitable since people not having the time, the resources or the will to attend classes can be reached through it. Solving concrete issue one after another insures that people are interested in the process and increases the likelihood of them persevering in the endeavor. It allows for unexpected forms of organization to develop and is adaptive. Ultimately, it is empowering. It reserves surprises for the "teacher" as well as for the student.

The challenge lies in bootstrapping the process, in other terms in convincing the local stakeholders that a new formerly unheard of form of knowledge can be of value to them. One possibility is finding a local partner who speaks both languages, who understands and uses the indigenous knowledge, but masters also the language of technology and science. At this stage, a more formal teaching approach may be needed in order to form such a partner. But here again, knowledge exchange, rather than knowledge provision proves to be a key-concept in integrating new forms of knowledge in traditional societies without losing the value of what indigenous knowledge brought to the community in the first place.

The COMMON-Sense Net project is proposing to local stakeholders an ICT system that will help them accomplishing more efficiently daily tasks in accordance with specifications they laid down themselves (in our case the information requirements for agricultural management). A hypothesis we want to verify is that such an approach will represent an incentive for farmers and their families to learn by watching and imitating, in particular in using the internet resources that can complement their knowledge of agricultural techniques. Evidently, such an interest can be raised only if the system is developed successfully in the first place. This raises a methodology question that we address in the next section.

METHODOLOGY: DESIGN SCIENCE (DESIGN & EVALUATION)

In our research we are confronted with the task of co-designing a locally relevant agricultural water management system embedded in an Indian rural community. Therefore, we aim at applying a participatory approach including the project stakeholders, their environment and their values in order to achieve sustainability. To fulfil this and achieve scientific rigour in our approach we apply the design science research methodology that has recently gained increasing scientific acceptance (March and Smith 1995; Hevner, March et al. 2004). Design science is an attempt to create things that serve human purposes, as opposed to natural and social sciences, which try to understand reality (March and Smith 1995; Au 2001). The generic iterative process of design is described by Takeda (1990) in Figure 3 and serves as a basis of reflection for the design process of a water management system in Chennakeshavapura. Ideally the design process steps are gone through conjointly by all stakeholders involved. In other words, villagers, farmers, academics and other parties involved first define a problem. Then they work out a suggestion. Thereafter

they design and develop a system, before proceeding to its evaluation. And, finally, the whole process restarts after the stakeholders' conclusions.

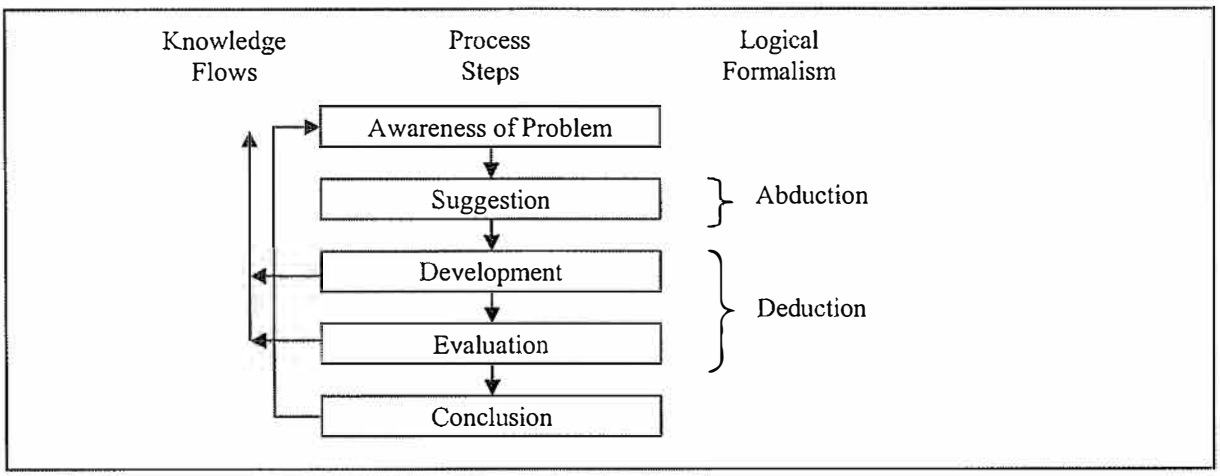

Figure 3: Reasoning in the Design Cycle (Takeda 1990)

At first sight, the COMMON-Sense Net project seems to be a typical infrastructure-based project. Such an observation raises immediate concerns about the acceptance of the developed technology, its sustainability etc. In particular, one may wonder how such a project will help building ICT capacity in a rural community mostly concerned with agricultural issues such as crop yield, climate variability, management of pests and diseases attacking the plants etc.

However, our claim is that far from being distinct, infrastructure building and knowledge creation as capacity building instrument are complementary. They may not only be achieved in parallel, but can leverage each other in a very efficient way.

A closer look at the methodology will substantiate this claim. The project is built as a set of iterations, working in spiral towards the achievement of the goal. Each iteration is built with phases matching those of the design science research framework. We start with the recognition and definition of a problem (agricultural water management in semi-arid areas of developing countries), propose a technology-based solution, then develop the appropriate system and evaluate its use and usefulness in the local cultural and social context, and draw conclusions for improvement, scalability and replicability of the approach.

However, since there is a substantial uncertainty as far as evaluation is concerned, we do not restrict ourselves to a single iteration, which is likely to lead to significant mismatches between the final artifact and its intended use. Consequently, we use several iterations (4 at the moment) from problem statement to evaluation in order to adapt the artifact to the local context in an incremental way. Each iteration is conducting evaluation of the output of the previous iteration and building of the output of the current one sequentially, and by using extensively a participatory approach (as will be shown in the list below). This can be described as a corrective iterative approach (CIPA).

Iterative processes are not uncommon in information systems design - see for instance the Rational Unified Process or RUP (Rational Unified Process, 1998). In our case, iterative design was made absolutely necessary by the uncertainties linked to the design of a technical artifact meant to translate the tacit requirements of a traditional society. The language gap and the initial unawareness of the local stakeholders of the capabilities of modern technology called naturally for a method were corrective approximations are made as the needs are being more explicitly expressed.

But the iterative method described here goes well beyond a traditional iterative software development process. In fact, we claim that it matches very closely the model of dynamic knowledge creation from

Nonaka et al. (2000), so that the project as a whole becomes as much a knowledge creation instrument as an artifact producer.

Each iteration, with its correspondence in Nonaka et al.'s (2000) model of knowledge creation and context, can be roughly decomposed into the following phases of the design cycle of Takeda (1990):

Phase 1 - Awareness: Community meetings (divided in sub-groups) conducted by local stakeholders and focusing on the needs of the community regarding agriculture. Constructs are built at this stage. The community meetings are led by a local farmer who is also an agronomist and is exactly what Heeks (2001), using Earl (1989) calls a "hybrid". This is a person who "understand(s) both context, organization, and work processes of their sector and the role of information systems" (Heeks, 2001). This phase corresponds to the socialization phase where tacit knowledge is transmitted as such. It is essentially internal to the rural community. At this stage, focus is put on information needs. Here, the *context* is the village and its surroundings. Ideally, the engineer should be present but silent.

Phase 2 - Suggestion: Translation into a technical language, participatory process involving the "engineer" and the hybrid described in phase 1. Phase 2 corresponds to the process of articulating tacit knowledge into explicit knowledge (externalization phase). This phase transcends the cultural boundaries, involving the engineer and the local farmer so that they end up integrating each-other's language. The *context* is the village and the laboratory, where the engineer and the hybrid can feed each-other's *constructs* with the relevant images and metaphors in order to build *models* through which the artifact may represent reality.

Phase 3 - Development: The design and development of an artifact involves a multidisciplinary approach since the expertise needed for tackling the issues spans the areas of hydrology, agronomy and teleinformatics. Phase 3 corresponds to the combination phase, where explicit knowledge into more complex and systematic sets of explicit knowledge. At the moment, it is unclear how this phase could concern not only the "technocrats", but also the local community. Consequently, we can only think at the *context* here being the laboratory where engineers from different disciplines use a technical design *method* to build an artifact.

Phase 4 - Evaluation: This consists of the presentation of the artifact and its capabilities. Here we seek to integrate the artifact in the community on a voluntary basis. This phase corresponds to the internalization phase where explicit knowledge is embodied into tacit knowledge. Here the two communities are involved again and the *context* is the village. The artifact must be presented with the utmost care such as not generating to high expectations to the farmers in the first phases, where its usage still has to be refined.

Phase 5 - Discussion and refinement of the artifact, according to local findings and input. This phase corresponds actually to the first phase of the next iteration.

Consequently, the whole process can be described not as a mere artifact design and implementation, but as a complex process of dynamic knowledge creation within a rural community, within a scientific community, and between the two, normally compartmented communities.

The methodology described above also shows the complementarity between apprenticeship and a participative method. Apprenticeship is involved in the 1st and 3rd phases of each iteration, but its outcome goes beyond the sole evaluation and reshaping of the artifact. It fosters a seamless integration of new cognitive paradigms in the local society. It the artifact is successfully designed and implemented, it presents technology as something concrete and immediately useful, not remote and abstract.

CONCLUSION

In this article, we present an engineering project aimed at coping with development issues in semi-arid agricultural areas of Southern India, the COMMON-Sense Net project. We claim that such a project, dealing with the interaction of a rural community with its environment, and putting ICTs to use in order to improve the understanding of this environment with the goal of improving the community's livelihood, can be fully compatible with the issues raised by the scientific community as far as ICT projects for

development are concerned (Heeks, 2001; Sein and Harindranath, 2003). Our hypothesis is that such a project, even if it focuses on a technical solution to a development problem, can foster the building of local ICT capacity and provoke ICT knowledge creation in original ways through apprenticeship and the use of participatory methods. Accordingly, we present concepts and a methodology to analyze this hypothesis.

This project is still in its infancy, since the participative gathering and analysis of the first environmental information requirements of the considered community were conducted in the first half of 2004. Many technical and social issues remain to be solved. Consequently, the claims made in this paper are yet to be substantiated and analyzed by the concrete results of the project. The first of the iterations described in section 0 will be fully completed in 2005. A full assessment of the capacity that was built during the first phase will permit to assess the methodogy used and to design the subsequent iterations in accordance to the findings.

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Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway

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Abstract

Based on the growing interest in internationalization in the information systems (IS) domain, this paper examines two attempts of internationalization. The first relates to a health information system for developing countries and the second concerns a telecommunication platform for premium rated SMS services. Discussing the experiences from these cases we use concepts from information infrastructure (II) as our theoretical and analytical lens. This analysis leads us to the articulation of an extended framework for theorizing and understanding the processes of internationalization. Our discussion engages with the inherent challenges of internationalizing IS, in particular the tensions related to control. Throughout the paper we will show that internationalization processes are highly contingent upon the IIs it is growing out from and into. The discussion will in particular concern the nature of standards and relations between the global and the local as well as the choice of a process or a product approach towards internationalization.

Keywords: *Internationalization, information infrastructure, control, flexibility, context sensitivity, standardisation, Mozambique, Norway*

1. INTRODUCTION

In this paper we discuss internationalization of information systems (IS) as a process with the aim to support the reuse of technical and human resources and building and sharing of knowledge across national borders. Accordingly, internationalization is pursued with the aim to reduce the costs of developing as well as implementing an IS as compared with starting from scratch in a new national context. Very much in line with current globalization processes, system development organizations are working to get and support the access to larger and possibly global markets. At the same time, new constellations of organizations such as multi-nationals are increasingly seeking to pursue international synergies on their disparate, scattered and disintegrated IS investments (Buss 1982). Internationalization is however a challenging endeavor, not only when linking developing and developed countries (for example Odedra-Straub 1992), but also within these different worlds.

The software design discipline has for decades discussed and appropriated the need for flexibility and compatibility. Decomposition and modularization, or loose coupling and close cohesion (e.g. Yourdon and Constantine 1979) have been identified as approaches to cope with the complex software systems. Based on these insights, researchers have engaged in providing adequate support for internationalization of software systems (for example Coronado and Livermore 2001; O'Donnell 1994; Russo and Boor 1993). Internationalization is understood as developing software systems to support localization, and ensuring their smooth adaptation in a specific national locale, for example to its different language, standards, legal requirements and cultural norms.

Management and development of international information systems (IIS) as a product have been discussed by organizational sciences as challenging for multinational corporations and their executives. Research in the IS field has addressed the variety of challenges related to standardization of inter- and intra-organizational IS in the strive towards universality and in particular to strengthen centralized control in global organizations (for example Ciborra et al. 2000; Ives and Jarvenpaa 1991; Rolland and Monteiro 2002). Drawing upon the lessons from software design, these studies have in particular illustrated how control over large scale systems can be challenged by lack of modularization and in particular local

variations in system implementations and work practices. Applying a socio-technical perspective, these studies have illustrated that control is in tension with flexibility, and that managing this balance is also related to issues such as diffusion of standards (Hanseth et al. 1996) and the inevitability of situated work practices (Ellingsen and Monteiro 2003). However, little attention has been given to internationalization as a process as well as to the unique contextual issues such as existing and available technologies, human resources and work practices where the IIS is to be localized and implemented.

The research reported here is based on two case studies of internationalization initiatives. The first case is related to a health information system, the District Health Information System (DHIS), developed in South Africa and its process of internationalization and implementation in Mozambique. The second case concerns a telecommunication platform for premium rated SMS services, the Content Provider Access (CPA) platform, developed in Norway and its process of internationalization and implementation in countries such as Denmark, Malaysia, Hungary, Ukraine, Thailand and Bangladesh. These cases are dissimilar in context, conditions, content and results. However, both cases represent initiatives with the same aim of internationalizing ISs, and thus allow us to get some relevant insights in the related processes and approaches. While we relate our discussions to the referred studies concerning standardization in the IS field, the ISs discussed here are by nature nationally fragmented and independent and the challenges of control are thus not related to attaining and sustaining organization-wide and centralized control. We primarily discuss control as the challenge of on the one hand implementing and preserving global standards and on the other implementing standards locally in a context sensitive manner.

The primary aim of this paper is to contribute with new conceptual insights in the challenges of internationalization processes and specially related to issues of control. Our primary research question is how internationalization relates to the context which it is growing out from and into. We will more particular focus on how approaches vary between internationalization of products and processes as well as how control in internationalization is pursued through standards and relations. Focusing on the balance between the local and global challenges related to universal solutions (Bowker and Star 1999; Rolland and Monteiro 2002), we engage in the discussion of the different facets of control.

The rest of this paper is organized as follows. In the following section we briefly discuss the theoretical basis followed by the introduction of the two case studies in section 3. Section 4 provides an analysis and discussion of the cases based on the theoretical perspective. Finally, in section 5 we conclude by drawing some theoretical as well as practical implications.

2. THEORETICAL BASIS: INFORMATION INFRASTRUCTURES

In this paper, we discuss internationalization with an II perspective, understanding the ISs as intrinsically composed of, interdependent and interconnected with collections of socio-technical components (e.g. Hanseth 2000; Hanseth and Monteiro 1997; Hanseth et al. 1996; Star and Ruhleder 1996). IIs are thus not relatively simple, standalone and self-contained systems, but rather represent large and open socio-technical networks of heterogeneous actors. These actors have different perspectives on and only partially control over the II (Neumann and Star 1996; Star and Ruhleder 1996). This perspective provides us with the means to study internationalization as a process framed within socio-technical networks. As we move beyond issues of centralized management and technical software engineering, this perspective help us recognize internationalization processes as necessarily both related to product and process and means of control spanning from standards to relations.

As internationalization necessarily involves several of these networks, i.e. the network where the IIS was initially developed and grows out from and the various local networks which it is growing into, internationalization processes are intrinsically complex as any centralized efforts of control only effects parts of the networks. It is thus highly challenging, yet essential to overcome the tensions with past infrastructures, procedures and practices (Timmermans and Berg 1997) by not being "installed base hostile" (Hanseth et al. 1996). Internationalization is therefore a process of cultivating the installed bases of the involved IIs. At the same time, the nature of these installed bases is highly influential in shaping the possibilities of control in internationalization processes on the global as well as the local level.

Standardization serves both as a mechanism for control and also introduces tension between the global and the local (for example Hanseth and Braa 2000; Rolland and Monteiro 2002). In internationalization, lack of standardization in local implementations will render impossible scalable control and further sustainable reuse. At the same time, the simplicity and efficiency of an internationally uniform solution from a global perspective can easily become suboptimal locally (Damsgaard and Truex 2000). However, control can also be attained and maintained through formal or informal relations between the global and the local actors. Based on the available means of control, this choice between global and locally optimal solutions in the relationship between IIS and its local implementations (LocalIS) must in any case be balanced, what Rolland and Monteiro describe as the "pragmatic balance".

3. CASE DESCRIPTIONS

The empirical materials we draw upon here originate from two independent case studies conducted by the authors respectively. The first case is based on an in-depth study of the development and the current operation of a platform for premium rated SMS services for mobile phones (the CPA platform) in Norway and related internationalization attempts. During 2003 and 2004, 39 semi-structured interviews where conducted with a variety of actors related to the CPA platform. While some interviews were conducted among Norwegian actors only involved with the implementation of the platform in Norway, other interviews concerned employees occupied with the internationalization process pursued by MobiNor, as well as those working with the implementation of the CPA platform in the affiliates of MobiNor in Denmark, Malaysia, Hungary, Ukraine, Thailand and Bangladesh. The second case study was conducted from 2000 to 2003 as part of an action research effort in a global research and development program known as Health Information System Project (HISP) (Braa et al. 2001). The fieldwork included working within a multidisciplinary team in Mozambique and making two visits to South Africa to interact with the software development team as well as attending a locally organized summer school.

3.1. Internationalizing a platform for premium rated SMS services

In 1999, the mobile phone network operators in Norway launched their CPA platform, enabling premium rated SMS services. The technical CPA platform builds on a business model which enables content providers to sell content directly to mobile phone subscribers through the mobile phone network, by the network operators allowing for premium rated SMS messages, i.e. enabling content providers to charge subscribers for more than the cost of regular peer-to-peer SMS services. Based on the two different network operators coordinating common short codes, price classes as well as a common service level, ease of access as well as a transparent market for the content was created. The operators did thus not choose to compete on differentiation with services exclusive provided in one of the networks, but on the contrary pursued an "open garden" approach. Branded and advertised by the content providers, the content becomes easy to use as any subscriber can order the content from the same short code for the same price. The typical content sold through the CPA platform comprises mobile phone ringtones and screensavers, jokes, Java games, news information, traffic information, weather information and phone directory services.

Content acquisition by subscribers is simply based on mobile phone subscribers requesting content by sending an SMS (Short Message Service) (figure 1) message. The SMS is processed by the SMS-centre (SMSC) of the network operator and forwarded to the content provider by the CPA platform. Upon request, the content provider returns the content by the CPA platform, and accordingly the cost which the subscriber is to be billed is specified with a rating class. Based on this, a billing request is sent by CPA to the billing system of the operator. The revenue generated is shared between the network operator and the content provider as per an agreed revenue-sharing model.

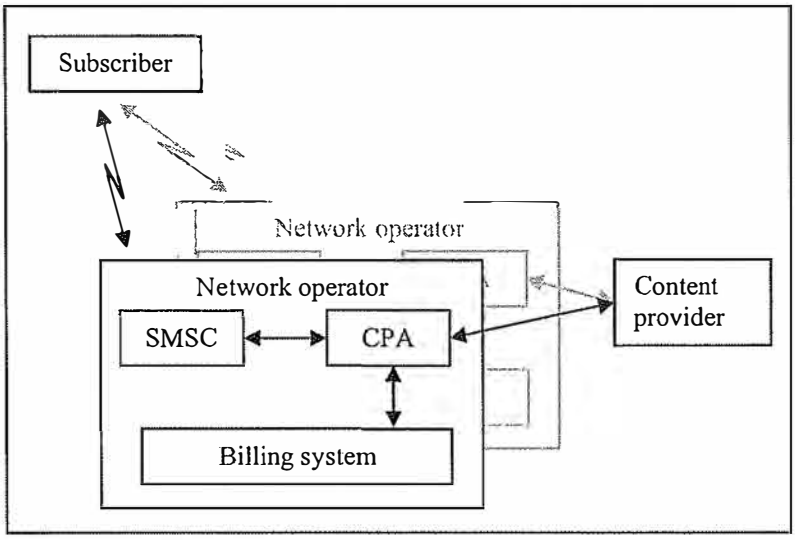

Figure 4 The basic components of the CPA platforms

The technical implementation of the CPA platform by one of the network operators, MobiNor, was based on a bottom-up initiative taken by a few key employees and drew upon relatively few resources. Only these employees really believed then in the underlying idea. Since MobiNor did not allow for an "open garden" approach, the implementation did not only lack management support but also violated the business and competitive strategies. However, coordination with employees from the other network operator as well as potential content providers quickly led to a successful platform and market for premium rated SMS services. The key challenge during this period was to create and maintain coordination between these actors as well as to develop a common appreciation of the platform. The platform implemented by MobiNor was technically an extension of an already existing facility for providing content services which was integrated with the billing system and the SMSC. The old platform, however, did not provide open access for content providers as well as a business model only providing exclusive content for MobiNor subscribers.

As the result of the continuous process of identifying interesting concepts for internationalization, CPA was in 2001 identified by the international division of MobiNor as an appealing platform for implementation in its various globally dispersed affiliates. This was only one project among others dealt with by this synergy area, and close related to the process of turning from a financial investor to an industrial investor towards the affiliates. Representatives of MobiNor traveled the affiliates' locations to introduce the platform and a related business case, as well as to provide consultancy services where required. This process was not based on internationalizing CPA as a software platform, at least partly as a result of recent failed attempts of internationalizing similar platforms. On the contrary, a "sharing of best practices" approach was adopted. Following this approach, personnel from Norway interacted with affiliates based on their knowledge of the platform's operations in the Norwegian context. This best practice has since been formalized as "12 guidelines for best practice", describing the need for an "open garden" approach, a symbiotic relationship between network operators and content providers as well as the ease of its use.

Affiliates situated in Bangladesh, Denmark, Hungary, Malaysia, Russia, Sweden, Thailand and Ukraine had implemented the platform by 2004. These affiliates have their own history and have adopted locally suitable approaches to provide premium rated SMS services while taking into account the national contexts, such as the maturity of the telecommunication market, the relationship among network operators and between network operators and content providers as well as the concerned regulatory regimes. These locally inspired (and, therefore different) implementations of CPA, reflects varying degrees of success. These differences are exemplified in the following examples.

Most affiliates offer mobile originating billing (MT-billing), i.e. billing the subscriber on the receipt of the content as shown in figure 1. Some of the network operators do, however, consider it more appropriate to base their billing on the subscribers' request of content (MO-billing). Technically, the former is enables

different models of billing, such as subscriptions to daily weather forecasts or receiving alerts when stock prices cross a certain threshold. MO-billing, on the other hand, renders it impossible to rate requests sent to the same number differently. This limits the flexibility available to content providers and adversely impacts ease of acquisition, thereby attenuating the potential for CPA's success envisioned in the guidelines.

Some sort of proactiveness from the network operators towards the content providers and an entrepreneurship-spirited approach by the latter are required to create a prosperous CPA market. Companies based in countries where content providers were not flourishing suffered from lack of content services and a weak market, such as in Thailand and Hungary. This was in sharp contrast to the situation prevailing in other markets, where a range of small entrepreneur spirited content providers were active in the market, both before and after the CPA business model was introduced, e.g. in Malaysia.

The maturity of the telecommunication market related to CPA is in particular dependent on the relationship between the network operators. In some of the markets where the network operators have had a long and fruitful history of cooperation (as in the case of Norway), while in some others, a "walled gardens" approach has been further exacerbated by strong mistrust among them. In one affiliate, cooperation among network operators was spurred by the content providers in context of the CPA, but no agreements to create a permanent open standard could be reached. In addition, the absence of informal interaction between the network operators thwarts coordination efforts.

The local implementations of CPA appear differently and have shown a highly varying degree of success. With an approach to internationalize on the level of best practices, and understanding CPA as closely linked to the variety of local IIs, this do not come as a surprise. The key aspects of the internationalization process are summarized in table 1.

Table 5 Key aspects of the CPA internationalization process

Platform based on bottom-up initiative, coordination among network operators and between network operators and content providers. MobiNor not in control in Norway, and affiliates not in control locally
No-standardized product, only visiting consultants from MobiNor. Non-standardized process in different in local contexts, and guidelines only describing "best practice" in Norway
The local implementations (as well as the original CPA platform) are thus highly dependent on the installed base of e.g. cooperation among operators and their proactiveness towards content providers as well as the existing billing systems and SMSCs.

3.2. Internationalizing a district health information system for developing countries

Initiated under the Health Information System Project (HISP), the district level computer-based health information system (DHIS) for processing of data received from Primary Health Units (PHU) was accepted as a national standard in South Africa in 1997. Together with an underlying open source philosophy driven by the overall goal to achieve equity in health, a participatory and bottom-up approach was seen as essential in its development (Braa and Hedberg 2000). Over the years, the DHIS has been regularly updated and its functionalities improved as per emerging management/community needs. Later versions have also taken advantage of the ongoing developments in hardware and software technologies, for example by way of designing more effective visual interfaces, incorporation of query-based reporting etc.

The DHIS combines both routine data from the health services and semi-permanent data on the health facilities like number of beds, equipment, staff, budget, population, etc. These types of data (also called denominator data) are linked to the indicators engine which allows defining and calculating indicators on any combination of data elements using the numerator/denominator framework. An important activity in the implementation of DHIS in South Africa was to identify the essential dataset (EDS) to provide an effective template for data collection by PHUs. The composition of EDS was finalized through a participatory process of consultations involving policy makers, health workers, computer system designers and communities. Acceptance of EDS by these stakeholders eliminated earlier redundancies in data collection, pinned down responsibility for collection and update of data elements, while also providing an

unambiguous framework to generate various reports at frequencies and formats desired by managers and other users.

In 1999, the HISP initiative was taken up in Mozambique. Based on it successful implementation in South Africa, as well as it emphasis on decentralization and participatory design, its strategies, processes and tools such as DHIS was transferred. Even if based on a success story from South Africa, the need for a deep understanding of the context including the health structures and information processes was identified. Priority was given to creating local teams and enrolling researchers and practitioners to undertake the localization process with central support from South Africa. The responsibility of the HISP team in South Africa is thus both to serve the local implementations of DHIS as well as to support a broader network. Since DHIS is based on open source, the users had full access to the source code, and could introduce changes according to their needs and local conditions. They were also allowed to freely revise the source code as well as redistribute it (Braa and Hedberg 2000; Braa and Hedberg 2002).

DHIS was initially not internationalized before its transfer to and piloting in Mozambique, simply because it was not originally meant to be used in contexts other than South Africa. The initial releases were thus designed and implemented to meet the language, format, culture and regulation requirements of South Africa. The change of strategy to also include internationalization suggested that the piloting now should involve support for localization, including changes related to e.g. creating a modularized and three tier architecture of user interface, functionality and database as well as adding new modules or other features. Several localization challenges were experienced, for example, the structure of the database reflecting the five levels of units in the South African health systems had to be changed to accommodate for the four levels in Mozambique. Other aspects related to language (Portuguese), naming conventions, hierarchical structure and levels also needed to be defined as starting point, at the level of the database, the user interface and the reports.

The adaptation of DHIS in Mozambique does not follow a remove-replace but rather an add-on strategy whereby e.g. new language support was added without modifying the original software. Since technical support was absent in Mozambique, all changes to the software were sent to South Africa for the manufacture of a setup CD. New CDs from South Africa acted as a new release with newly added features and bugs fixed. The testing of the new release was conducted in the piloting sites, and further changes required were sent back to the main hub in South Africa, where the setup CD was again manufactured and subsequently sent back to Mozambique for testing and use.

The multiple adapted release cycles of the DHIS software suggested an endless process of interaction (with South Africa), whereby the integration of the new releases implied starting more or less from scratch. The new initiatives and features locally implemented in Mozambique are at the same time not necessarily relevant and even compatible to the new releases generated for internal use in South Africa. At the same time, however, the initiatives taken up have contributed to the global DHIS software. Although at a conceptual level the continuous release cycles with South Africa could be discarded in the favor of an autonomous approach, in practical terms such procedure was not feasible in Mozambique. The nature of interaction between Mozambique and South Africa, emphasizing collaboration and sharing of experiences have up until now developed a stable and mutually beneficial long term relation.

The key aspects of the DHIS internationalization process are summarized in table 3.

Table 6 Key aspects of the DHIS internationalization process

Standardized and centrally controlled DHIS software by South Africa, but also bottom-up, participatory and open source implementation approach locally
Software not internationalized initially but over time. Bottom-up and user centered development leads to no standardization on process
The implementations of DHIS highly dependent on the installed base of e.g. technical and human resources available in Mozambique as well as the specificities of language, the health care system and the local practices

4. ANALYSIS AND DISCUSSION

Different in context, conditions, content and results, the CPA and DHIS cases point to a variety of challenges related to the process of internationalization. While following different models and based on different standards and relations between the global and the local, these cases in particular illustrate internationalization processes as being continuously struggling with its interrelated IIs and its related tensions of control.

4.1. Control through standards and relations

Even if a process of internationalization have been pursued in both the CPA and the DHIS case, the nature of the local implementation are not simply controlled and determined globally by Norway and South Africa respectively. While MobiNor have pursued an approach without any technical standards resulting in little if any centralized control, South Africa has controlled the development of DHIS to a larger extent by centrally producing standardized software.

Since the content of internationalization has been kept at the level of providing guidelines in the case of CPA, the benefits accruing from this process are lesser as compared to the software development scenario in the case of HISP. The reasons why MobiNor have not followed a more rewarding internationalization process in terms of synergies can on the one hand be attributed to the history of the relationship between MobiNor and its affiliates, which has primarily been based on financial investments. On the other hand, this approach can also be attributed to the close technical relationship between CPA and the local implementation of the SMSC and the billing system. A technically standardized CPA platform would not only impact these platforms, but also require other actors in the local markets to adhere to the standard. While agreements have been made over time between these actors in the local markets, none of the affiliates of MobiNor have been able to impose one standard in their local context. Control is thus not only a local-global issue, but is diffused over a network including the affiliates and their control in the local context. The important roles of the installed base (in particular technology and human resources) also applies to the HISP case, where the global team (in South Africa) has little power when it comes to the actual implementation and use of the software out in the field.

Where standards as a means of control are not applicable, however, control can also be exercised by the relations between the global and the local actors. These relations are shaped by aspects such as resources available locally, history of cooperation, and distance between the actors. For example, in Mozambique, the key people related to the development and implementation of DHIS is not permanent field staff but primarily PhD students working part-time for the HISP project. Thus, Mozambique has been dependent upon the support from South Africa even if local resources slowly develop over time. On the contrary, the relations in the case of CPA have been weak and the initiative from MobiNor has been continuously challenged not by the lack, but rather by the presence of resources and local initiatives originating from the affiliates. Some affiliates have also been reluctant to seek support from MobiNor, but rather from other sources such as successful Norwegian content providers. Based on experiences with earlier attempts of internationalization, the risk of disfranchising the local technology and initiatives have been one important factor deciding the soft approach pursued by MobiNor.

The choice of approach of internationalization, e.g. through standards or relations and their inter linkage, is strongly related to the history as well as the means of control. The local installed bases of components, such as technology, human resources as well as the relationship between the local actors are strong determinants when it comes to creating feasible approaches. Where the installed base is weak, as in the case of Mozambique, control can be easier to achieve through standards than in the case of CPA where the installed base is complex.

4.2. The tension between flexibility and standardization

In the case of HISP, a key issue is how to centrally incorporate and locally align software and processes introducing participatory design and creating flexible software solutions based on an open-source philosophy. This was not easy to achieve as the three-tier architecture implemented in the DHIS software suggests that data storage, user interface and functionality are separate entities. This flexibility does, however, allow Mozambique to introduce changes to any of the three levels. The question thus raised is which aspects should be under local and which should be under global control? Further, this points out how

using a standardized process, i.e. participatory design, results in a non-standardized product. This complexity related to internationalization is further illustrated by the case of CPA where the guidelines for best practice only describe the principles adopted for its success in Norway. The guidelines do, however, not describe how to build the network of actors from bottom-up, pursue management to engage in an "open garden" approach and settle the relationships among the network operators.

The flexible approach in the CPA case can be argued as being appropriate for different contexts, by reflecting sensitivity to the rather heterogeneous contexts of implementation. However, such an approach has lead to unstructured situation in which some of the LocalIS do violate the very rules of the best practice. In particular, due to reluctance of the network operators to adopt an "open garden" approach, the suggested coordination to develop the platform has failed. Facing the challenges of linking the various affiliates together to create synergies, MobiNor is currently in the process of planning to standardize other technologies and platforms, such as the SMSC and billing systems, both closely linked to the CPA platforms. Even if the managerial focus is currently not on the CPA, future progress on standardizing other platforms may lead to a need for a global CPA standard. However, taking into account the various existing IIs, we should also understand each implementation of CPA as framed within and sensitively adjusted to a local network of already existing components. The affiliates' local struggle with controlling this network can be equally or even more challenging than the globally initiated internationalization process as well as other standardization initiatives.

Standardized implementation processes may lead to non-standardized products. When approaches focused on being context sensitive, e.g. bottom-up and participatory, are applied, flexibility will be pursued at the cost of standardization and global control. In such cases, however, the relations between the global and the local can play an important role in coordinating the internationalization process towards a standardized outcome.

4.3. Internationalizing Information infrastructures

In our discussion, we have extended a relatively simple model of software transfer and pointed out various facets of control in the relationship between IIS and LocalIS. The distinction between the process of internationalizing and local implementations tend to become less clear, and their relationship also stretches back to the legacy of the initial IS as well as forward to local adaptations. As II develops over time as an intricate and heterogeneous network of actors, internationalization initiatives can be highly complex and further limited in their achievements. For example, in the case of CPA, the nature of the platform is very much dependent on the nature of the billing system and the SMSC of MobiNor, as well as of the other network operators in Norway. In addition, the informal relationships amongst the network operators and between them and the content providers have been decisive for its implementations. These relationships are impossible to internationalize. In parallel, DHIS has to struggle with the local specificities of language and the hierarchical structure of the health sector, suggesting the need for DHIS to be conservatively designed to allow for these local adaptations.

The implementation of DHIS is highly dependent on the installed base of e.g. technical and human resources available in Mozambique as well as the specificities of the health care system and the local practices, while the local implementations of CPA are largely dependent on the cooperation among operators and their proactiveness towards content providers as well as the existing billing systems and SMSCs. At the same time, however, attempts to implement LocalIS will not automatically succeed if all resources, actors and components are present as the coordination between them will develop and shape over time. Thus, the challenges of control related to internationalization is not only related to a global perspective but also, and probably more important, to the local.

5. IMPLICATIONS

Applying an II perspective has helped to lift the discussion of internationalization from a technical perspective to a socio-technical perspective situated in a context defined by both local and global influences and relations. Our implications in the form of two models (figure 2) abstract different approaches to internationalization. Model 1 illustrates how IIS not necessarily are developed from scratch, but spawned by an already existing IS and it's surrounding and interrelated IIs as we have pointed out in the case of DHIS. Model 2 illustrates how localization can also take place directly from an IS, and thus with less

flexibility and support for reuse as in the cases of CPA and DHIS initially. Model 2 is thus highly contingent upon the presence and continuity of locally available human resources and competencies.

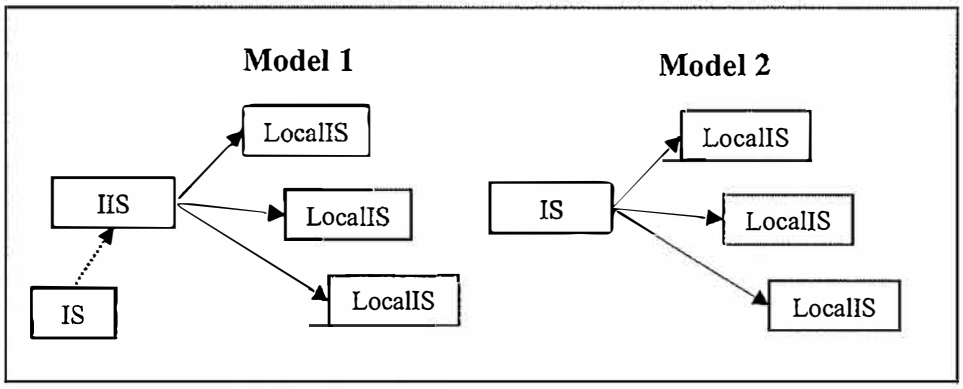

Figure 5 Extended models of internationalization

While these models are very different related to the interaction between the IIS and its various local implementations, internationalization processes can over time change from one model to the other. In the case of HISP, initial attempts of internationalization directly from an IS in Mozambique, as in model 2, over time brought out the necessity for an IIS and the process was changed to model 1. While CPA have followed model 2, a further internationalization of platforms such as the SMSCs and billing systems could lead to the revival of model 1.

In this paper we have shown that internationalization of ISs is a highly complex endeavor involving not only technology, but also human resource capacity, relations and IIs. This process is close related to controlling the relationship between the global and the local. At the same time we have illustrated how local implementations of internationalized products and processes cannot escape local IIs. These local socio-technical networks play an important role on the means, the freedom and the needs for internationalization and more particular control at the global and local level.

Internationalization and localization should neither be understood nor treated as different and subsequent processes. Such a distinction does not take into account the interrelatedness of internationalization processes and can easily mislead us to interpret internationalization success or failure as solely determined by centralized efforts of internationalization and control. Even if the very end of an internationalized IS is not meant to be one centralized system, we should also understand each local implementation as a part of a larger network. In particular to capture internationalization as being a process, the universality (if any) of the network cannot be developed by introducing one standardized solution. Our discussion suggests that the global - local relationship and the tension between the control (through standardization and relations) and flexibility must be balanced reciprocally and pragmatically between the local and the global over time. To practically approach internationalization, we suggest to exercise control through a blend of standards and relations. At the same time, and most challenging, this process of blending will not solely rest with one, central actor, but will be distributed across the socio-technical network.

Internationalization aims to support the reuse of technical and human resources. However, the consequences of internationalization for local human resource development are uncertain, in particular depending on whether internationalization is pursued by process or product strategies. A standardized product strategy will not necessarily aid local human resource development because it will require less of such local competencies. Where internationalization is pursued with a more flexible and open process strategy, local competencies will necessarily have to be in place, engaged and developed in the process of localization. We argue that while choosing between process and product strategies, in particular related to the degree of standardization, the consequences for human resource development must be taken into consideration.

While internationalization will have consequences for human resource development, it will also be shaped by the existing human resource capacities. The adversary conditions of developing country contexts call for strengthening human and technical resources, while at the same time this "void" can enable the ISs to be built from scratch. One should however be cautious to interpret a "void" of technical infrastructure as a "void" of social networks and practices. At the same time, presence of technology and knowledge is not necessarily the optimal condition for successful internationalization since changing socio-technical networks are maybe more challenging than creating them.

While standards and networks of relations in internationalization can transport products and processes, the stability of the standard and network itself will be highly dependent upon which support is provided by those promoting and supporting internationalization. While our perspective does not give one recipe for how to blend control in internationalization processes, it directs us towards understanding ISs as parts of larger global and local IIs with their own history, content and trajectory.

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Gender Differences in Mobile ICT Use: An Empirical Investigation in Two Developing Countries

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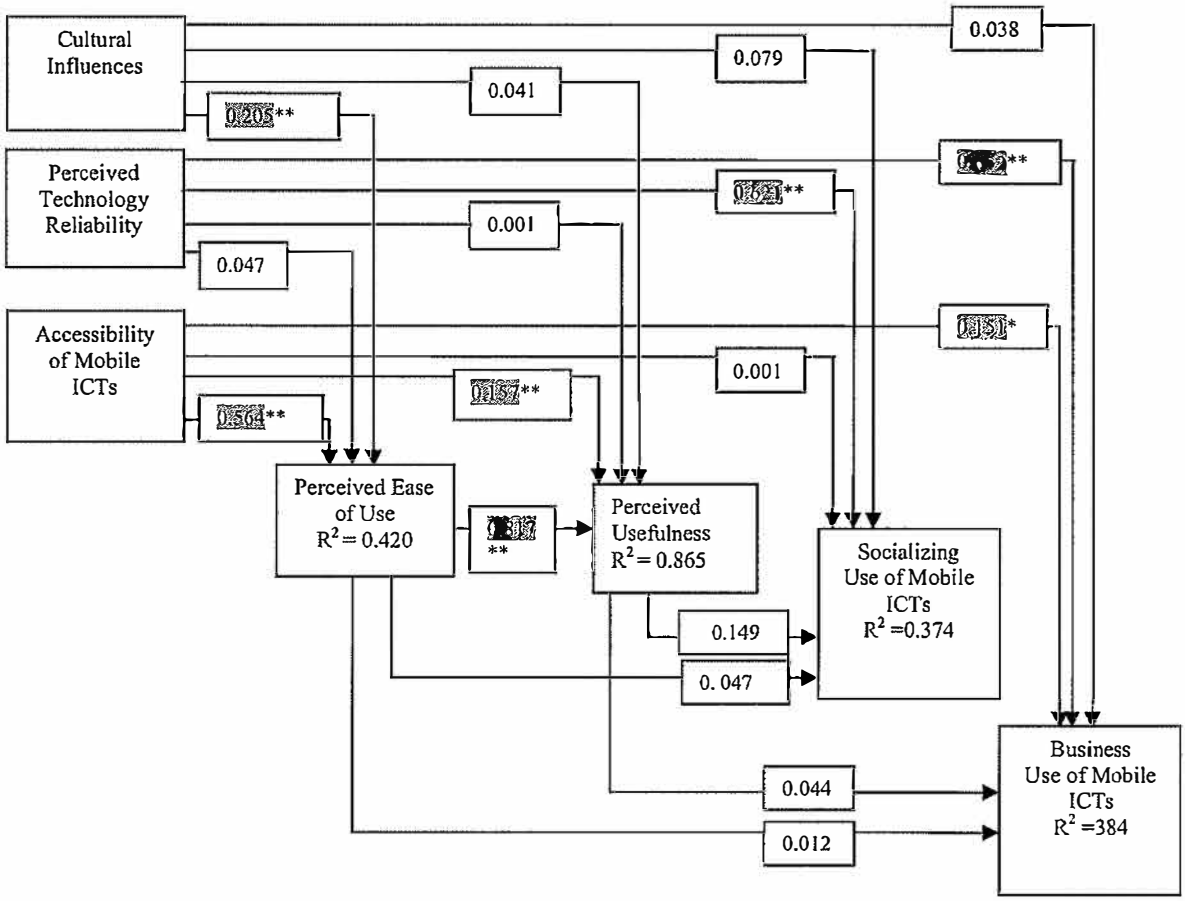
ABSTRACT:
Gender and technology studies have found that men and women adopt technology differently. Men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use. Women and men differ in their perceptions of, but not their use of, email technology. Further, men and women may view the same mode of communication differently. This being the case, we chose to examine if indeed there are gender differences in the perceptions of the factors that influence technology acceptance, especially within a developing region context as provided by Sub-Saharan Africa (SSA). Results indicate that, for the most part, the factors that influence use of mobile ICTs in SSA are robust of gender.

INTRODUCTION

Gender and technology studies have found that men and women adopt technology differently (Gefen & Straub, 1997; Venkatesh & Morris, 2000). Men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use (Venkatesh & Morris, 2000). Women and men differ in their perceptions of, but not their use of, email technology. Further, men and women may view the same mode of communication differently (Gefen & Straub, 1997; Ono, 2003). This being the case, we chose to examine if indeed there are gender differences in the perceptions of the factors that influence technology acceptance, especially within a developing region context as provided by Sub-Saharan Africa (SSA).

In a study on mobile ICT use in the developing countries, Meso et al. (In print) examined a number of factors that influence mobile ICT use, specifically mobile phone usage, by individuals in a developing country context where mobile ICT devices and their use are still emerging. Figure 1 provides their research model and the statistical results of the partial least squares (PLS) analysis of their study's data. Using technology acceptance theory and published research on technology use, they found that the key factors that influence mobile ICT use included **perceived culture influences** (Kim, 2003; Rose et al., 2003; Walsham, 2002; Walsham & Sahay, 1999; Madon, 1997) on acceptable usage of the technology, and the **perceived reliability** of the technology (Anandarajan et al., 2000; Gefen et al., 2003; Legris et al., 2003; Venkatesh & Morris, 2000), **Accessibility of the technology** (Agarwal & Venkatesh, 2002; Anandarajan et al., 2000; Majchrzak et al., 2000; Vasan, 2001) **perceived usefulness** and **perceived ease of use** (Gefen et al., 2003; Grover & Ramanlal, 1999; Rose & Straub, 1998; Venkatesh, 1999). Meso et al. (In Print) further identified that while accessibility had a major impact on the business use of mobile ICT, its impact on socializing use was not significantly strong. However, perceptions about mobile ICT's reliability had significant impacts on its business and socializing uses respectively.



* indicates that the item is significant at the $p < 0.05$ level ($t > 1.96$)

** indicates that the item is significant at the $p < 0.01$ level ($t > 2.57$)

Figure 1: Factors influencing Business and Socializing Use of Mobile ICT in SSA

Their study found that gender was not a key influence on the ways users used mobile ICTs. An earlier study by Gefen and Straub (1997) found gender as having no influence on the perceptions of the social presence of email, or actual use of email. However, the study found differences in how women perceive e-mail's ease of use and usefulness when compared to men. In both studies a direct causal effect of gender on the variables of the technology acceptance model is assumed and investigated. However, the comparative difference between the perceptions that males hold when compared to those held be women is not directly examined. Therefore, we undertake to investigate the differences in perceptions among the genders. Rather than examining the direct effects of gender on use, we use gender to classify the respondents with a view to examining if there are differences in the causal model for the male respondents as compared to that for the female respondents. We base our study on the work of Meso et al. (2004) given that we have the data set that they used for their study. Therefore, we adopt the same model they employed and re-examine the factors that they found to be significant from the context of gender specific samples. This being the case, we hypothesize that:

There is a difference in how males and females, perceive the relative importance of the five factors that influence the social and business use of mobile ICT – namely, cultural

influences on acceptable uses of mobile ICT, reliability of mobile ICT, accessibility of mobile ICT, ease of use of mobile ICT, and usefulness of mobile ICT respectively.

We define these constructs below:

Culture: Many studies have determined that culture has a strong contextual influence on whether and how individuals, organizations, and societies employ ICT (Hofstede, 1991; Kim, 2003; Myers, 1999; Rose et al., 2003; Walsham, 2002). These findings demonstrate that (1) technology diffusion differs across cultures, (2) the technology-diffusion patterns in a given culture are influenced by the culture's beliefs, norms, and values, among other cultural dimensions, and (3) different cultures tend to prefer different technology.

Technology Reliability: The TAM identifies user perceptions about a technology as being key determinants of whether the technology gets used (Anandarajan et al., 2000; Gefen et al., 2003; Legris et al., 2003; Venkatesh, 2000). Though the two types of perceptions that have been extensively studied are a technology's perceived ease of use and its perceived usefulness, we expect that perceptions about a technology's reliability will also influence the degree to which the technology is used. Individual consumers are bound to be less confident in a technology that is not reliable and would thus limit its use.

Accessibility of Technology: ICT use also depends on the technology's degree of accessibility and ready availability (Madon, 1997). TAM presumes that the technology being studied is readily accessible. In situations where access to the technology is not limited or constrained by any set of extenuating circumstances, then the attitude towards using the technology and subsequently the intention to use the technology are shaped by a subject's perception of the technology. However, where access to the technology is constrained, then the subject's attitude towards adopting the technology is, to some extent, affected by whatever impediments exist to constrain their accessing the technology. This has been the situation for most of the technology users in resource-poor countries such as those in sub-Saharan Africa (Madon, 2002).

We therefore posit that accessibility of technology influences a subject's perceptions about the technology. Further, we argue that constrained access influences the subject's perceptions about the technology's true usefulness and ease-of-use. For one, where the technology can not be readily accessed, subjects are prone to perceive the technology as not being easy-to-use, when in actual fact it is easy to learn how to use the technology and relatively simple to apply the technology to the performing or relevant applications. We also argue that where access is greatly constrained, then subjects may place a higher value on the technology than its true usefulness – perceiving it to be more useful (or as deriving greater utility – in economic terms), than is actually the case.

TAM Antecedents: Traditional TAM studies have indicated that many factors drive the acceptance of a given technology (Agarwal & Karahanna, 2000; Anakwe et al., 1999; Majchrzak et al., 2000). Davis (1989) identified two key factors that influence the decision to adopt a specific technology: perceived ease of use and perceived usefulness. Past studies on TAM have consistently supported the significance of these factors in influencing adoption behaviour. Further, these studies have shown that perceived ease of use also influences perceived usefulness. The ensuing section describes the research methodology.

RESEARCH METHODOLOGY

a) Data Collection

We used a survey to empirically examine and evaluate the study's hypotheses, basing the survey instrument on technology transfer, technology diffusion, and end-user computing literature. We developed the survey instrument—a questionnaire—to measure individuals' perceptions of technology and core factors that we thought would influence an end-user's reaction to mobile ICT. The constructs that were used in the study and their respective survey items are presented in Appendix 1.

b) Analysis of Survey Respondents

As Table 1 shows, we received 198 responses from 122 males and 76 females—a 33% response rate. Of the 198 respondents, 8 did not indicate that they used mobile ICTs. Given that the method of data analysis that we used allows for missing data cases to be included in the statistical tests, we did not exclude these 8 cases. The respondents ranged in age from 18 to 60 years, and had an average work experience of 8.18 years. On average, the respondents indicated that they had completed at least a high school education. We used the Likert scale to measure all survey items, except those that provided personal information about the individual.

A comparison of the responses from the two countries (Table 2) indicated that they did not differ in their rating of cultural influences on the use of mobile ICT, except for one item (question 15). However, there was a significant difference in the mean age, and education level of respondents. As reflected in the data analysis section, these two factors had no significant influence on how individuals used mobile ICT – even when the respondents from each country are tested independently. This being the case, we found no justification for separating the data into two samples based on country or respondents.

TABLE 1: Descriptive Statistics of Respondents by Gender

ITEM	GENDER	N	Minimum	Maximum	Mean	Std. Deviation	Mean Difference	t	Sig. (2-tailed)
AGE	MALE	121	20	60	35.132	8.230	8.058	6.357	0.000
	FEMALE	54	18	45	27.074	6.515			
	BOTH	175	18	60	32.646	8.578			
WORK EXPERIENCE	MALE	109	0.25	31	9.115	6.921	3.888	3.623	0.000
	FEMALE	41	0.3	20	5.227	5.405			
	BOTH	150	0.25	31	8.052	6.751			
EDUCATION	MALE	108	1	6	3.889	0.868	0.139	1.009	0.315
	FEMALE	48	3	6	3.750	0.758			
	BOTH	156	1	6	3.846	0.836			

* Likert scale of 1 to 6 used to measure education level with 1=no formal schooling, 2=primary certificate, 3=high school certificate, 4= bachelors degree or equivalent, 5= masters degree or equivalent, and 6= doctoral degree or equivalent; N=number of cases used in determining mean and std. Dev.

TABLE 2: Descriptive Statistics of Respondents by Country

ITEM	Country	Valid N	Minimum	Maximum	Mean	Std. Deviation	Difference in mean	p-value
Age	Both	187	18	60	32.813	8.649	3.1	.05
	Nigeria	150	20	60	33.427	8.835		
	Kenya	37	18	60	30.324	7.450		
Education Level*	Both	165	1	6	3.879	0.832	.48	.003
	Nigeria	131	2	6	3.977	0.827		
	Kenya	34	1	5	3.500	0.749		
Cultural* Influence q14	Both	192	1	6	2.86	1.58	.44	.132
	Nigeria	156	1	6	2.78	1.51		
	Kenya	36	1	6	3.22	1.82		
Cultural* Influence q15	Both	196	1	6	2.77	1.64	1.62	.000
	Nigeria	159	1	6	2.46	1.54		
	Kenya	37	1	6	4.08	1.40		
Cultural* Influence q16	Both	195	1	6	3.1	1.31	.33	.173
	Nigeria	158	1	6	3.16	1.26		
	Kenya	37	1	6	2.84	1.52		
Cultural* Influence q17	Both	195	1	6	1.48	0.80	.34	.072
	Nigeria	158	1	6	1.42	.71		
	Kenya	37	1	6	1.76	1.06		

* Likert scale of 1 to 6 used to measure education level with 1=no formal schooling, 2=primary certificate, 3=high school certificate, 4= bachelors degree or equivalent, 5= masters degree or equivalent, and 6= doctoral degree or equivalent; N=number of cases used in determining mean and std. Dev.

c) Statistical Analysis of the Research Model

The statistical method employed is borrowed from Chin (http://disc-nt.cba.uh.edu/chin/plsfaq/plsfaq.htm, accessed February 2005) and entails two core steps. First is a test of the research model using Partial Least Squares (PLS); a structural modelling technique well suited for highly complex predictive models (Chin, 1997; Gefen et al., 2003; Wixom & Watson, 2001). Second is a statistical comparison of the results derived from the execution of the research's PLS model using the two data sets in PLS graph software.

RESEARCH RESULTS

This section reports the results for both the PLS analysis, and the ANOVA comparison of results as per the methodology proposed by chin et al. (http://disc-nt.cba.uh.edu/chin/plsfaq/plsfaq.htm, accessed February 2005)

(i) PLS Analysis of the Research Model

In the first step, the PLS model is executed in PLS Graph software using two different data-sets – one for the male respondents, and the other for the female respondents. This yields two sets of PLS Graph analysis data that is then used in the subsequent step. PLS makes it possible to assess the measurement (the research model's constructs) and the structural (the hypothesized relationships among these constructs) portions of a Research Model. Therefore for each data set (males and females), we evaluated the measurement model, and the structural model properties. For the measurement model, PLS provides estimates of the internal consistency, convergent validity, and discriminant validity of a study's constructs. In a survey-based study such as this, these constructs are operationalized by the items on the survey instrument used to survey a given population. The respondents' responses to the items on the survey instrument provide the data for this analysis (Chin & Newsted, 1999; Fornell & Bookstein, 1982; Joreskog & Wold, 1982; Wixom & Watson, 2001).

Validation of the internal consistency is normally performed for the reflective items in the measurement model only (Chin, 1997; Gefen et al., 2003; Joreskog & Wold, 1982; Wixom & Watson, 2001). Table 3 presents the internal consistency results of both the male and the female PLS graphs. All reliability measures were above the recommended level of 0.60 for exploratory research (Nunnally, 1967; Wixom & Watson, 2001).

Table 3: Internal Consistency Reliability Assessment

	Internal Consistency	
Factor	males' pls graph	females' pls graph
Access	1.20912016	2.65559616
Reliability	2.47621696	3.01230736
Cultural Influences	1.91102976	14.799409
Perceived Ease Of Use	7.73729856	7.79470561
Perceived Usefulness	3.38596801	3.54079489
Business Use	5.022081	2.04089796
Socializing Use	4.25803225	3.88681225

Convergent validity is adequate when either of two conditions are met: (i) constructs have AVE of at least 0.5 (Fornell & Bookstein, 1982; Gefen et al., 2000; Wixom & Watson, 2001), or (ii) when items load highly (greater than 0.5) to their respective reflective constructs (Wixom & Watson, 2001). Table 4 shows the factor loadings of each item on their associated constructs for both the male and female PLS graphs. All but two items has loadings greater than 0.5.

The AVEs for the constructs in both the male and female PLS graphs are presented in Table 5 as the bold figures listed on the diagonals of the study's correlation matrices. Reviewing both AVEs and item loadings we are satisfied that the model meets the requirements for adequate convergent validity.

Discriminant validity is satisfied when the average variance extracted (AVE) for each construct is greater than the variance shared between the construct and other constructs in the model (Fornell & Bookstein, 1982; Gefen et al., 2003; Wixom & Watson, 2001). As is evident in Table 5, for both the male and female PLS graphs, all AVE figures are greater that the corresponding correlations of the constructs in the research model. Therefore all constructs satisfied the condition for discriminant validity.

Table 4: Discriminant Validity and Convergent Validity Assessment

FACTOR	Item	Males' PLS Graph		Females' PLS Graph	
		Loading	T-Value	Loading	T-Value
Access	q23	-0.0997	-0.4533	-0.6925	-5.4541
	q47_e	-0.9999	-50.3601	-0.9371	-43.578
Reliability	q13	0.9559	43.1471	0.9229	56.2387
	q56	0.6177	5.5601	0.8127	9.4424
Cultural Influences	q57	0.5568	2.8597	0.8984	7.0794
	q58	0.8446	4.8511	0.9826	23.6363
	q59	0.1101	0.2833	0.982	7.8063
	q63	-0.1291	-0.3991	0.984	3.634
Perceived Ease Of Use	q49_g	0.9052	22.1671	0.9259	29.6536
	q50_g	0.9528	63.8951	0.9109	18.0463
	q53_g	0.9236	30.0345	0.9551	44.5392
Perceived Usefulness	q51_g	0.9403	77.1491	0.95	49.6145
	q54_g	0.8998	18.9873	0.9317	25.7858
Business Use	q15_b	0.8726	18.4132	-	0
	q14_a	0.585	4.1484	-0.4607	-2.2883
	q14_b	0.7834	8.9604	-0.9679	-28.4687
Socializing Use	q14_d	0.5852	2.8666	0.8045	6.1219
	q14_e	0.6703	4.7488	0.5495	2.7632
	q15_a	0.808	9.377	0.6175	3.2046

Table 5: Convergent Validity Assessment

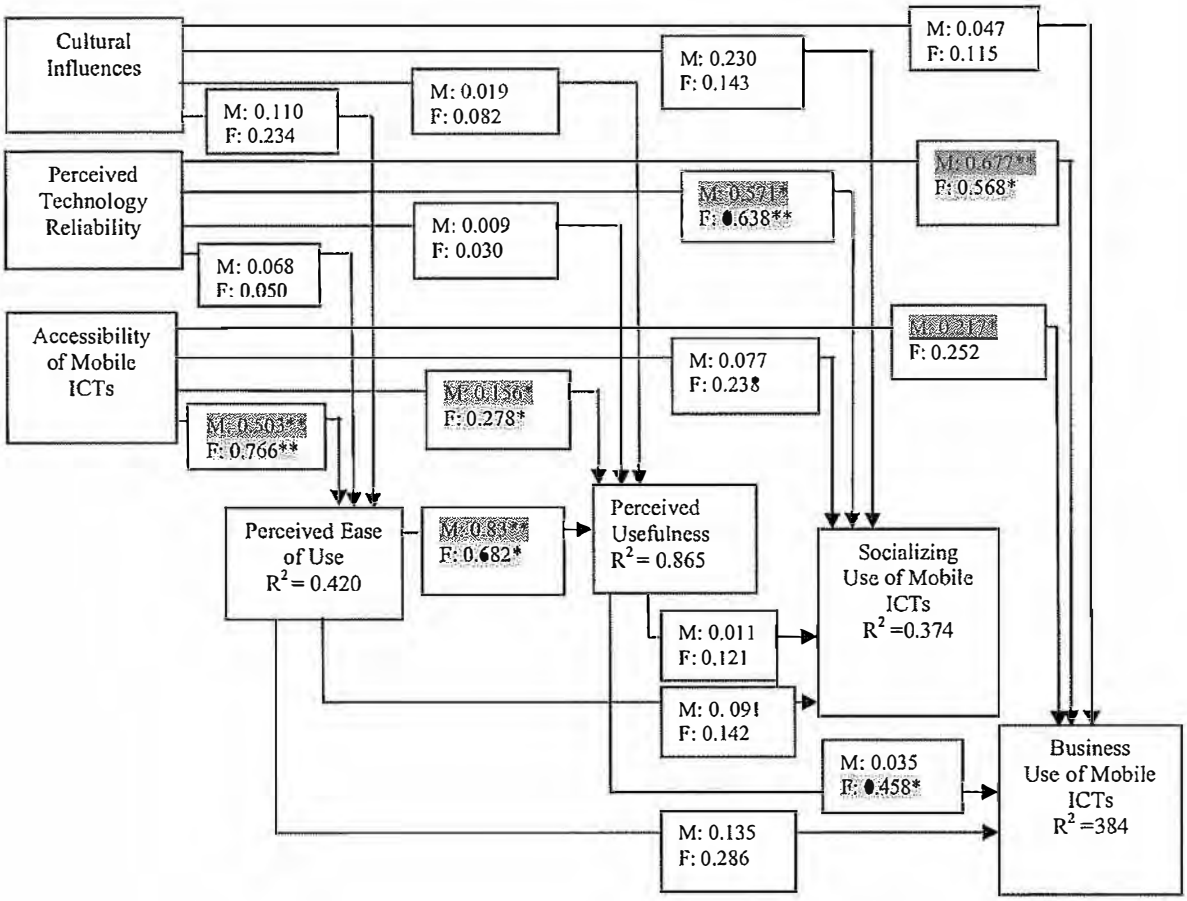
Average Variance Extracted (Ave) And Correlations For Males' PLS Graph

	Access	Reliability	Cultural Influences	Perceived Ease Of Use	Perceived Usefulness	Business Use	Socializing Use
Access	**0.711**						
Reliability	0.362	**0.805**					
Cultural Influences	-0.171	-0.337	**0.513**				
Perceived Ease Of Use	-0.546	-0.287	0.219	**0.927**			
Perceived Usefulness	-0.609	-0.297	0.192	0.914	**0.920**		
Business Use	-0.016	0.585	-0.215	0.017	0.011	**0.694**	
Socializing Use	0.126	0.598	-0.391	-0.091	-0.095	0.577	**0.757**

Average Variance Extracted (Ave) And Correlations For Females' PLS Graph

	Access	Reliability	Cultural Influences	Perceived Ease Of Use	Perceived Usefulness	Business Use	Socializing Use
Access	**0.824**						
Reliability	0.283	**0.870**					
Cultural Influences	-0.171	0.001	**0.962**				
Perceived Ease Of Use	-0.792	-0.167	0.365	**0.931**			
Perceived Usefulness	-0.824	-0.162	0.379	0.927	**0.941**		
Business Use	-0.168	-0.588	0.035	0.054	0.017	**0.619**	
Socializing Use	0.045	0.598	0.125	-0.039	0.003	-0.135	**0.666**

In PLS, the structural model tests, entail estimating the path coefficients and the R^2 values. These tests provide the information necessary to assess the hypotheses in a research model. *Path coefficients* represent the strength of the relationships between dependent and independent variables. These need to be significant and directionally consistent with expectations. The *R^2 value* represents the amount of variance explained by the independent variables, thereby providing insights into the model's predictive power. Together, both explain how well the structural model is performing (Chin & Newsted, 1999; Fornell & Bookstein, 1982; Joreskog & Wold, 1982; Wixom & Watson, 2001). Figure 2 presents the Path coefficients and R^2 values of the structural paths in both the male and female PLS graphs respectively.



*: indicates that the item is significant at the $p < 0.05$ level ($t > 1.96$)

**: indicates that the item is significant at the $p < 0.01$ level ($t > 2.57$)

M: indicates result for the Males PLS Graph

F: indicates result for the Females PLS Graph

Figure 2: Results from the PLS Graph Analysis

As is evident from figure 2, both males and females reported accessibility as significantly influencing perceived ease of use and perceived usefulness of mobile ICTs. Both also indicated that perceived ease of use significantly influences perceived usefulness of mobile ICTs. This is a clear

indication that the nature and extent of access does influence the perceptions that individuals hold about a specific technology. It is also indicative of the fact that diffusion of mobile ICTs and other IT technologies is Sub Saharan Africa can be leveraged by enhancing their accessibility. Several ways proposed of enhancing accessibility include making the technologies more affordable, placing them within easy reach of citizenry – e.g. in the small rural towns, or in public facilities such as libraries, post offices and schools.

We also observed that both males and females reported that technology reliability significantly influences the socialization and business uses of mobile ICTs. Inferences drawn from this is that accessibility by itself is not a sufficient condition for enhancing the diffusion of mobile ICTs. The technologies so diffused need to be reliable too. The issue of technological quality of the ICT products diffused in the region thus becomes important. While there has been a tendency to provide "hand-me-down" near-obsolete equipment as donation the developing countries, this finding indicates that such donations may not be benefiting the diffusion if ICTs in sub Saharan Africa. The lessons we lean from the meteoric diffusion of the cell-phone, a surrogate of mobile ICTs, is that provision of affordable high quality ICTs in such a manner that they are within easy reach by consumers enhances the diffusion of ICTs.

Finally, while the males indicated that accessibility significantly influences the business use of mobile ICTs, the females did not feel the same. This observations may be due to the cultural setup in this region where males tend to be the key income-earners for their families and thus are more bent to assessing technologies from the perspective of how the technologies enable them to generate more income rather than on how they would better facilitate socialization. However, it may be an indication of the cultural specific perspectives of technologies – where males perceive mobile ICTs as tools of trade and income generation while women perceive them as tools for socialization. We should state however, that this finding remains, at best, inconclusive.

(ii) T-Test Comparison of the Male and Female PLS Graphs

In the second step, a statistical comparison of the results derived from the execution of the research's PLS model using the two data sets in PLS graph software is performed. The t-test for difference in independent samples method is used to perform the statistical comparison of the results derived for the male and female data sets. The procedure on how to perform this t-test is borrowed from statistical analysis methodology proposed by Chin (2005). Specifically, we take the path coefficients and the standard errors of the structural paths provided by PLS-Graph's structural model analysis. Treating them parametrically, we hand calculate the t-test for the difference in paths between the two research groups (males and females). Table 6 presents the results of the ANOVA analysis.

Table 6: T-Test Comparison of Path Coefficients from Male and Female PLS Graphs

Independent Variable	Dependent Variable	Path Coefficient		Standard Error		T Value For Difference In Path Coefficients			
		Males PLS Graph	Females PLS Graph	Males PLS Graph	Females PLS Graph	T Value	Levels Of Significance		
							alpha=.1 (t>1.645)	alpha=.05 (t>1.960)	alpha=.01 (t>2.576)
accessibility	Perceived Ease of Use	-0.503	-0.766	0.1126	0.0755	1.9400	✓		
	Perceived Usefulness	-0.156	-0.278	0.062	0.1628	0.7003			
	Business Uses	-0.217	-0.252	0.0705	0.2274	0.1470			
	Socialization Uses	-0.077	-0.238	0.0895	0.1887	0.7709			
reliability	Perceived Ease of Use	-0.068	0.05	0.0799	0.0683	-1.1226			
	Perceived Usefulness	-0.009	0.03	0.0394	0.0396	-0.6982			
	Business Uses	0.677	-0.568	0.0713	0.4512	2.7255			✓
	Socialization Uses	0.571	0.638	0.4447	0.095	-0.1473			
cultural influences	Perceived Ease of Use	0.11	0.234	0.1042	0.2592	-0.4439			
	Perceived Usefulness	-0.019	0.082	0.0567	0.1055	-0.8433			
	Business Uses	-0.047	0.115	0.1471	0.0966	-0.9205			
	Socialization Uses	-0.23	0.143	0.1157	0.0841	-2.6077			✓
Perceived Ease of Use	Perceived Usefulness	0.83	0.682	0.6388	0.5417	0.1767			
	Business Uses	0.135	0.142	0.1502	0.3004	-0.0208			
	Socialization Uses	0.091	-0.286	0.2135	0.3806	0.8639			
Perceived Usefulness	Business Uses	-0.035	-0.458	0.1643	0.2625	1.3659			
	Socialization Uses	-0.011	0.121	0.1873	0.246	-0.4269			

Surprisingly, there was not much statistically significant difference between males and females reported perceptions of how the various factors influence the use of mobile ICTs. There were only three instances where a statistically significant difference was observed. The first is in the reported influences of accessibility on perceived ease of use of mobile ICTs. Here, the difference in the impressions of males and females on the influences of accessibility on perceived ease of use were statistically significant, with females reporting stronger scores. This pattern was also evident in the difference perceived technology reliability on business uses of mobile ICTs, and cultural influences on socialization uses of mobile ICTs. However, in these later cases the males reported stronger scores.

Inferences from these results are that the factors that influence mobile ICT use are robust of gender. This makes it easier for technology firms to develop appropriate strategies for leveraging mobile ICTs in the region. It also makes it straight forward for government agencies to develop policies that foster growth of mobile ICTs. The findings indicate that policies that foster the accessibility and reliability of mobile ICTs will enhance diffusion and use of these technologies in the region. Likewise, marketing strategies that leverage accessibility and reliability may prove to be more effective for the technology companies, than strategies that promote other issues – such as gender differences in mobile ICT use, mobile ICT aesthetics, or mere brand-name recognition. A case in point is the growth of SafariCom (http://www.safaricom.co.ke/2005/default2.asp?active_page_id=334&id=107, Accessed February, 2005) as a cell-phone and wireless communication services provider in Kenya at the expense of the then more established and better known Kencell corporation. Safari com was able to grow its subscriber base by providing reliable mobile ICT services in a consumer friendly strategy to a larger geographic area in Kenya than its competitor. It did this by (a) using the pay-as-you-use strategy made possible by prepaid calling

cards rather than billing consumers via the conventional monthly billing statements; (b) providing low per-minute calling rates as opposed to its competitor who preferred to target the elite market segments such as corporations and charge them at higher per-minute calling rates (c) not charge clients for receiving calls on their cell phones and for using text messaging (the firm now charges a marginal fee for text messages); and (d) using the land-lines infrastructure of its parent firm, Kenya Posts and Telecommunications, to ensure that cell-phone services were accessible in the most rural locations in Kenya, a different strategy from its competitor who chose to concentrate on the urban markets (East African Standard, 2004 : http://www.csk-online.org/html/us_firm.htm). Therefore by extending its reach and range, and using a billing strategy that even the poorest persons could afford, the firm was able to win over 70% of the cell-phone market share in Kenya within a short period of 5 years.

IMPLICATIONS AND CONCLUSION

The growing convergence of the Internet and mobile communications means that mobile ICT devices are increasingly becoming an integral part of an electronic and computer-mediated business infrastructure (Mbarika et al., 2002; UNCTAD, 2002). For many people in developing countries, mobile handsets may be the first and main means of accessing information and communication applications, such as the Internet and e-commerce (Mbarika et al., 2002; UNCTAD, 2002). For example, many countries use Short Message Service (SMS) to deliver commercial messages to mobile phone users. While most handsets do not have Internet access, they support commercial SMS, which is being used effectively to promote the sale of goods or services whether or not it invites or solicits a response from a recipient. Given that mobile phones outnumber personal computers, they become a logical channel for m-commerce in developing countries (Minges, 1999).

ICT is especially viewed as having a direct impact on the nature and productivity of a nation's business sector. UNCTAD (UNCTAD, 2002) reported that, "The introduction of wireless communications has not only expanded telephony in many developing countries, but also introduced wireless data services which are essential for conducting m-commerce." We concur with this perspective and view the diffusion of mobile phones as being a first step in the diffusion of M-commerce. As consumers become comfortable with using mobile phones as tools for business, they will find it increasingly easier to appreciate and therefore adopt portable computing devices, which are the base connection points for M-commerce, and integrate these into their business practices. In a region where electricity, water, railroads, airlines, and so on are generally government owned and operated, m-commerce could serve as a vessel for improving the quality of life for the region's 770 million inhabitants.

As this study has shown there are no significant differences between males and females in sun Saharan Africa on how they perceive factors that influence the use of mobile ICTs. Further, the same set of factors that males perceive as critical are also perceived as such be females. This is an indication of the robustness of these factors and clearly elucidates the factors that government policy makes and private firms need to focus on in leveraging mobile ICT use in the region.

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Internet Cafés – Venues for Learning in Developing Countries

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ABSTRACT

This paper examines the use of Internet cafés as venues for learning in two developing countries, Indonesia and Tanzania. The aim is to find contextual explanations of differences in use patterns between various user groups. The research is based on surveys in the two countries, supported by in-depth interviews. The findings suggest that Internet cafés are suitable arenas for human resource development for a wide range of users. Access speed, price and spare time are the three most important obstacles to increased use. More research is needed to see how Internet cafés can attract new groups of users, to help reducing the digital divide within a developing country.

INTRODUCTION

Huge differences exist in the accessibility of the Internet among countries and regions, reflecting a global 'digital divide' and 'information poverty' in parts of the world. In addition, within developing countries we see clear tendencies of increased concentration of information flows to urban and central areas (Wong, 2002; Mwesige, 2004). Economically disadvantaged countries and rural and peripheral districts within these nations tend to fall further behind in human resource development as well as in economic progress and political participation.

Expansion of Internet access in poor areas is facilitated by arrangements for public use, such as Internet kiosks, cybercafés, or multipurpose community telecentres (Rogers and Shukla, 2001). The Internet café (or cybercafé) concept has been successfully spread to poor countries mainly because it combines a reasonably priced access to the Internet with the comfortable environment of a coffee house or a bar and the chance to socialise with fellow users and to pick up new knowledge and ideas in computer usage.

In spite of the increasing importance of Internet cafés, very limited research has been reported on their diffusion, even in areas of Asia and Africa, where they represent a major means of access to digital information and communication. Internet cafés can be a vital venue for learning and thus developing human resources in poor countries. In this paper, we examine whether this is actually happening.

The paper is based on research conducted over a 3-year period on Internet café entrepreneurs and users in Indonesia, and corresponding research in Tanzania that started in 2004. Although the research in Tanzania is in its early phase, we have found interesting comparative indications between the two countries, which make further extensive research promising.

The main objectives of this paper are to find contextual explanations of differences in Internet café user frequency and pattern in Indonesia and Tanzania. We thereby aim at presenting useful information for the start-up of Internet cafés in information-poor areas of developing countries and motivate for using Internet cafés for national human resource development through individual competence building.

The article is organised as follows. After this introduction, we present the theoretical basis from relevant literature, followed by an overview of the socio-economic context and the spread of the Internet and Internet cafés in Indonesia and Tanzania. Section four describes the methodology and data collection. Our empirical findings are depicted in section five. In section six we present the conclusions, limitations, and prospects for further research.

INTERNET CAFÉS IN THE DEVELOPING WORLD

Privately owned Internet cafés increasingly represent opportunities for ordinary people in economically poor areas to access the Internet. In such venues, computers are made available at various rates and connection speed, enabling regular or occasional customers to search for information and make electronic connections with others via e-mail and chatting. Internet café employees normally provide valuable guidance in Internet use and information access to inexperienced users. The fact that mainly operational costs are incurred in the payment for Internet use represents a huge advantage in economically poor contexts. Fixed costs from the purchase of equipment and leased lines are left to the business owners and only charged to the users according to the time spent on-line.

In Indonesia, two thirds of Internet users gain access through Internet cafés (Kristiansen, Furuholt and Wahid, 2003), and policy documents from Tanzania indicate that Internet cafés are the main means of Internet access in Tanzania as well (Tanzania Ministry of Communications and Transport, 2003).

Other sources of Internet access are Telecenters and Internet access points. The differences between Telecentres and Internet cafés are mainly related to ownership, financing, and variety of services. Telecentres operate mostly as 'not-for-profit organisations', relying on various sources of external funding. Internet cafés normally represent profit opportunities for the owners and are based on service fees above costs (Salvador, Sherry and Urrutia, 2003). Internet cafés also normally offer additional bar or dining services, or ordinary kiosk businesses, but their main offer is concentrated around Internet use. Information Access Points are represented by an increasing number of terminals for short-term rent in shopping malls, airports and other public sites, especially in developed areas of the world.

Empirical studies of Internet users remain under-represented as an area of academic research (Lee, 1999). Even less research is conducted on users of Internet cafés, and very few reports are from developing countries. Mwesige (2004: 84) notes that "the world-wide boom of Internet cafés has not seen corresponding inquiry into this form of public access to the Internet".

Numerous studies have been conducted, however, on the adoption of the Internet technology in a global context (Madden et al., 2000; Kiiski and Pohjola, 2002; Grubesic, 2002). The majority of cross-national work on this topic has been limited to OECD countries, while some studies are also conducted with a specific focus on the developing world (Zhu and He, 2002; Wilson and Wong, 2003; Wolcott and Goodman, 2003). An extensive study of Internet diffusion is being executed by The Mosaic Group through The Global Diffusion of the Internet (GDI) Project (http://mosaic.unomaha.edu/gdi.html) where nearly 30 countries have been studied over time. Per capita income seems to be the overall most important factor explaining global inter-country differences in the Internet usage rates. Other technological and economic determinants of statistically significant value include telephone and personal computer densities (Beilock and Dimitrova, 2003) and Internet access cost (Kiiski and Pohjola, 2002).

The extension of infrastructure for the use of the Internet in developing countries has generally been much slower than in economically rich parts of the world. This is mostly due to low demand and thereby low profitability of ICT businesses. The disparity in the intensity of ICT adoption among countries is wider than the disparities in their GDP per capita, indicating that the digital divide is also increasing and likely to become even more severe in the future (Wong, 2002).

Kling (1999) argued that Internet use is a question of social as well as technological access. Technological access refers to infrastructure and the physical availability of computer hardware and software, while social access refers to the mix of professional knowledge, economic resources, and technical skills required for the use of ICT. It appears that the use of the Internet in developing countries in general and of Internet cafés in particular is dominated by young and relatively wealthy people, mostly well educated and predominantly male citizens of urban areas (Robbins, 2002; Mwesige, 2004).

To study the adoption of Internet, researchers have used established theories from the Information Systems literature. Davis' (1989) concepts of 'perceived usefulness' and 'perceived ease of use' still have a dominant position in the stream of theories and models on ICT user acceptance. As regards Internet use, Oyelaran-Oyeyinka and Adeya (2004) have documented that 'ease of use' is regarded a major constraint even for academics in Kenya. Quibria et al. (2003) have found that Internet use and tertiary education show significant statistical association in Asian countries. The ease of use variable normally becomes less significant with increased experience among users (Szajna, 1996). This suggests that Internet use may increase when users gain knowledge and experience.

Demographic factors, like gender and age, were not included in the original technology acceptance models (e.g. Davis, 1989). Venkatesh et al. (2003) have assessed the dominating information technology acceptance models and developed a 'unified theory of acceptance and use of technology' (UTAUT), where four main factors empirically are found to dominate the speed and rate of adoption. The four factors are 'performance expectancy', 'effort expectancy', 'social influence', and 'facilitating conditions'. In addition, their model comprises demographic factors. Age and gender significantly moderate the basic variables in explaining ICT user intention in their studies.

We shall, therefore, in the following concentrate on contextual and socio-economic explanations to variations in Internet and Internet café use between and within developing countries.

SOCIO-ECONOMIC CONTEXT AND IT INFRASTRUCTURE IN INDONESIA AND TANZANIA

Today, both Indonesia and Tanzania are multiparty democratic republics. Indonesia achieved independence from the Netherlands in 1949 while Tanzania, a merger of Tanganyika and Zanzibar, became independent from the UK and was formed in 1964.

Indonesia, the fourth most populous and largest Muslim country in the world with close to 240 million people, still suffers from the severe Asian economic crisis in 1997, and the country is at a critical stage in the process of democracy building. More than 40 million people are unemployed (Jakarta Post, 2003). Disparities are huge between rich and poor and between 'inner' and 'outer' parts of the country. There is a concentration of economic activities and political power in the island of Java. Information asymmetry follows disparity, and entry barriers into business as well as politics are persistently higher among the poor and peripherally located. The rapidly increasing numbers of Internet users represent a potential step in the direction of more equitable access to information.

With 37 million people and an area of 945,000 square km, Tanzania has 15% of Indonesia's population on 50% of the area. Tanzania remains one of the least urbanised African countries; urban population is only one-third of the total. The per capita GDP is estimated to less than one-fifth of Indonesia's, but is probably understated because of the size of the informal sector. According to the Tanzania national website (2004), 2.3 million people are unemployed, but the majority of people are self-employed and most of the work is seasonal in the agricultural and informal sector. SIDA (2001:7) concludes: *"Tanzania is a country of paradoxes. On the one hand the economic climate has improved, but on the other hand severe poverty persists. Multi-party democracy has been introduced, but poor people still have few chances of influencing their own futures".*

Some national statistics, describing Indonesia and Tanzania is depicted in table 1, below. The difference between them, regarding social, financial and technological status is significant; Indonesia looks far more developed than Tanzania. The size and per capita GDP have been mentioned above. The age structure, life expectancy, literacy rate, poverty and health problems (e.g.HIV/AIDS) are in clear disfavour of Tanzania.

The population of Tanzania is far younger than that of Indonesia, with more than 44% of Tanzanians younger than 15 years. The average age in Tanzania is calculated to 17.6, compared to 26.1 years in Indonesia, a difference of 8.5 years. While people in Tanzania can expect to be 44.4 years, statistically, Indonesians have a life expectancy of 69.3 years, almost 25 years older. Both countries have a large share of poor people, one-fourth in Indonesia and one-third in Tanzania. The literacy rate is also higher in Indonesia, but the difference is rather small. Compared to its neighbouring

countries, Tanzania has a relatively high literacy rate. It is worth noticing, however, that the difference in literacy between men and women is significantly larger in Tanzania.

In Indonesia, 88% of the people are Muslims. Less than 10% are Christians and there are small minorities of Buddhists and Hindus. The Tanzanian population is divided into three large segments, Muslims, Christians and indigenous beliefs. The UK Foreign and Commonwealth Office (2004) estimates the distribution to be 45% each of Muslims and Christians and 10% of traditional beliefs.

Both Indonesia and Tanzania have their lingua franca. Bahasa Indonesia is the dominant and official language and is spoken all over Indonesia. In Tanzania most people have their own, local language, many of them are very different from each other. Kiswahili has become the lingua franca of eastern Africa and is the official language, spoken by all Tanzanians. From secondary school level, all teaching is in English, the second official language of Tanzania.

Table 1
Country statistics

	Indonesia	Tanzania
Area (sq. km.)	1,919,440	945,087
Population (mill.)	238.5	36.6
Labour force (mill.)	100.5	13.5
Age structure (%)		
0-14 years:	29.4	44.2
15--64 years:	65.5	53.2
65 -> years	5.1	2.6
Life expectancy at birth (years)	69.3	44.4
Religion (%)		
Muslim	88	38
Christian	8	30
Other	4	32
Literacy (%) *(Age 15 and over can read and write)*	88.5	78.2
Total	92.9	85.9
Male	84.1	70.7
Female		
GDP; purchasing power parity (Billion $)	758.1	21.6
GDP per capita ($)	3,200	600
Population below poverty line (%)	27	36
Unemployment rate (%)	10.5	12.9

Sources: CIA (2004) and Tanzania national website (2004)

The telecommunications and ICT infrastructure, as described in table 2, shows significant differences between the two countries, as well.

In spite of modest ICT expenditures and a low number of Internet hosts, the use of the Internet in Indonesia is growing quickly. The number of Internet service provider (ISP) licenses issued increased from one in 1994 to 180 by the end of 2002 (Purbo, 2002; APJII, 2004). The number of Internet users increased by more than 770% between 1998 and 2002, from 512,000 to 4,500,000. APJII (2004) predicted that the number will be 12 million by the end of 2004. Given Indonesia's large population of 220 million, the density of Internet users is still low, slightly more than 2%, and lower than the density of phone lines (3%). (Directorate General of Post and Telecommunications, 2001).

The Tanzania Communications Commission (TCC) has licensed nine companies to provide data communication services including Internet bandwidth. As a result of their policy, Tanzania lacks cheaper and high capacity connections to the global Internet, and there is a large unsatisfied demand in the country for Internet access (Tanzania Ministry of Communications and Transport, 2003). The number of ISPs in Tanzania increased from one in 1993 to 23 in 2002, providing between 10,000 and 15,000 subscribers (Tanzania Ministry of Communications and Transport, 2003). The number of Internet users has been difficult to trace. CIA (2004) estimates the number to be 80,000 in 2002. This gives a density of Internet users counting 0.2%, or one-tenth of Indonesia.

Wahid, Furuholt and Kristiansen (2004) estimate the number of Internet cafés in Indonesia to be around 2000. The cafés are highly concentrated and the vast majority is found in the larger cities on the centrally located and densely populated island of Java. Other major agglomerations include the tourist sites of Bali and Lombok.

There are no reliable statistics on the number of Internet cafés in Tanzania. Tanzania Ministry of Communications and Transport (2003) reports that Cyber cafés are reputed to be over 1,000, more than any other sub-Saharan African country, while SIDA (2001:17) states that *"the number of Internet cafés in operation in Tanzania is hard to assess. Estimates from 'insiders' range from 100 to 1,000, with the most realistic estimate being 300-400"*. Other sources (e.g. web-directories and our own experience) indicates that SIDA's number are the most realistic. About half of these are found in the biggest city, Dar-es-Salaam.

Table 2
Telecommunications and Internet statistics

	Indonesia	Tanzania
Telephones – main lines in use (mill.) - 2002	7.8	0.2
Telephones – mobile cellular (mill.) - 2002	11.7	0.7
Teledensity – (lines per 100 people) – 2002	3	1.2
ISPs – 2002	180	23
Internet hosts – 2002	61,279	1,731
Internet subscribers	667,000	14,000
Internet users – 2002	4,500,000	80,000
Television broadcast stations – 1999	41	3
Internet cafés – 2002	2000	300-400

Sources: Directorate of Post and Telecommunications (2001), Tanzania Ministry of Communications and Transport (2003), APJII (2004), SIDA (2001)

DATA COLLECTION AND METHODOLOGY

This paper is based on recent surveys of users of Internet cafés in the city of Yogyakarta in Indonesia and in 3 towns in Tanzania. Our previous research on Internet cafés in Indonesia has focused on the business owners (Kristiansen, Furuholt and Wahid, 2003) and on the diffusion of the Internet café innovation (Wahid, Furuholt and Kristiansen, 2004). Previous in-depth interviews with business owners (eight) as well as with users (seven) in Yogyakarta and Lombok prepared the ground for developing a questionnaire (in the Indonesian language). Draft versions of the instrument were tested on a number of respondents before the final version was decided. The questionnaire has formed the main research instrument for this study, while a number of additional in-depth interviews with customers have helped in interpreting statistical findings. 11 users were interviewed in six Internet

cafés in Yogyakarta, while 10 were interviewed in Lombok. Some quotations from the in-depth interviews in Yogyakarta are presented in our empirical discussion.

The questionnaire respondents were all customers whom we physically met in Internet cafés in Yogyakarta, Indonesia during November - December 2003 and in Tanzania during January-February 2004.

The area of Yogyakarta city was divided into five geographical clusters based on main lines of demarcation. In each cluster, we randomly selected three Internet cafés. The number of venues for data collection thus became 15, which is 10% of the total number of Internet cafés in the city. In order to get the most realistic picture of Internet use, questionnaires were distributed at three different times of day. Within each time period we collected responses from six Internet café users at each venue. The total number of respondents is 270.

In Tanzania, the survey is to be considered a pre-study. It is based on the same questionnaire as in Indonesia, translated to Kiswahili. The survey took place in three towns, Iringa, Songea and Mbeya, in the south-western part of the country, along the main road from Dar-es-Salaam towards Malawi and Zambia. The three cities are all mid-size, with between 100,000 and 200,000 inhabitants. None of them are typical university-towns or tourist sites. Seven Internet cafés were visited, with no specific selection criteria, three in Mbeya, three in Iringa, and one in Songea. This resulted in a sample of 63 respondents. We have, so far, no in-depth interviews from users in Tanzania.

EMPIRICAL FINDINGS AND DISCUSSION

Table 3 presents the user statistics. It shows that one main difference between the research sites in Tanzania and Indonesia, is the role of Yogyakarta as one of the main university sites of Indonesia. This was reflected in the composition of the respondents. Fully three-fourths of the Indonesian respondents were students, compared to half in Tanzania. Some of the differences can therefore (partially) be explained by this, for example average age, marital status and educational level.

One-third of the Indonesian Internet café customers were women, which is a higher percentage than could be expected in a poor, dominantly Muslim society. In Tanzania the female share is lower, only one-fourth. One explanation to this could be a lower literacy level among Tanzanian women, as described in table 1 (section 3), above, or the large number of students among the Indonesian respondents. We will investigate this closer in the next phase of the project.

The age difference looks marginal between the two national user groups, and might, to some extent be explained by the population composition (see above). But, looking at the age distribution of the total population, where Tanzanians are, on average, more than 8 years younger than Indonesians, we observe that the Tanzanian Internet café users are older than we could expect based on the Indonesian figures.

We find significant differences regarding educational level. Some could naturally be explained by the proportion of students among Indonesian users. It is, however, interesting to observe that while the proportion of users with university education is fairly equal, almost half of the Tanzanian users have only elementary education. Less than one out of twenty Indonesian users have only finished their primary education. This finding is interesting to study closer to find ways to attract a wider range of user groups to Internet cafés in general. Our own research from Indonesia, supported by Mwesige (2004) from Uganda, states that the typical user is well educated.

While there were almost none governmental employees among the Indonesian users, 16% of the Tanzanians had governmental positions. One explanation could be the lack of alternative places to access the Internet for this group. According to SIDA (2001:28), *"the level of automation (in the governmental sector) is low and is exacerbated by shortage of skills, equipment and money"*. There are a surprisingly high share of unemployed people among the Tanzanian users, considering the relatively (compared to per capita GDP) expensive fees.

Tanzania is categorised as one of the poorest countries in the world. Even if Tanzanians, on average, are poorer than Indonesians (one-fifth of the per capita GDP), the Internet café users there spend

60% more money as a total and 60% more on Internet café fees than the Indonesians. There are various potential explanations to these numbers, but so far it is difficult to find rational answers.

Table 3
Descriptive statistics – the IC users

	Iringa, Mbeya and Songea in Tanzania	Yogyakarta in Indonesia
Number of respondents	63	270
Gender distribution, Male/Female	75/25	68/32
Age – average	24.7	22.2
Marital status – single	82.0	92.6
Education		
Elementary	44.5	4.4
High school	23.8	57.8
University (diploma/Bachelor/Master)	31.7	37.1
Employment		
Students	46.0	72.2
Self employed	11.1	9.3
Governmental	15.9	.7
Private company	14.3	12.2
Unemployed	12.7	4.4
Monthly total expenditure	Tsh 109,000 = *USD 103.80*	Rp535,000 = *USD 62.20*
Monthly spending in Internet cafés	Tsh 11,233 = *USD 10.70*	Rp 56,000 = *USD 6.51*
Internet café fees, price per hour	Tsh 500-1,000 = *USD 0.50-0.95*	Rp 2,500-3,000 = *USD 0.29-0.35*
Skills and knowledge		
Computer knowledge	2.68	2.80
Internet knowledge	2.85	2.75
English proficiency	3.85	2.73
Frequency of use of Internet cafés – days/month	12.8	9.1
Time spent per Internet café visit – hours	1.5	2.6
Alternative places to access the Internet		
Home	6.5	5.9
at work place	6.3	11.1
at school/university	16.1	23.7

1 USD = 1,050 Tanzanian shillings (Tsh) = 8,600 Indonesian rupies (Rp)

Our impression is that all users spend surprisingly much money on Internet café fees. One remarkable finding is that both Tanzanian and Indonesian Internet café users spend 10% of their monthly expenditures on Internet café fees.

Users in the three towns in Tanzania visit the cafés more frequently than Indonesians in Yogyakarta, but they spend shorter time per visit. Altogether the two groups spend nearly the same time in the Internet cafés during one month. This might be considered in association with more alternatives for Internet access for Indonesians.

Even if the educational level is significantly higher among the Indonesian users, the two groups have remarkably equal perception of their own computer and Internet knowledge. There is, however, a clear difference in the understanding of their own English language proficiency. On a scale from one to five (five is best), the Tanzanian user scores as high as 3.85, and more than one unit higher than the Indonesian does. The explanation is, most probably, the wide use of the English language in the Tanzanian school and society.

When looking at the various types of use of Internet cafés, some discrepancies in the statistical material have, so far, made it difficult to compare the exact, nominal numbers from the two countries. That is why we have chosen to present the types of use ranked (table 4 and table 5, below) and we will supply the explanations with numbers from the underlying material.

One main result from our surveys is that the Internet cafés, to a high degree, are used for competence development. Seeking information (rank 2) and research (rank 4), both fall into that category, while e-mail, reading news, downloading information and software for professional use, and doing business all may contain important elements of competence building.

The correspondence between the two rankings is more striking than the differences, showing that the use of Internet cafés seems rather uniform in different type of context in different countries. We register a slightly stronger tendency of entertainment in Tanzania than among Indonesian users, while reading news is ranked more popular in Indonesia. These indications are further confirmed, when studying the concrete numbers behind the ranking.

Through in-depth interviews, we have tried to trace the change, or development, in Internet café use for various user groups. Many, especially young people, are starting with pure entertainment and socialising, like chatting, games etc. We have, however, found that the use changes over time, being more "serious" or useful after a while. Purnomo, the owner of an Internet café in Yogyakarta told us: *"After the economic crisis – users are more selective in their spending. Generally, there is a change in motivation for using the Internet café among students. They used to use the Internet for entertainment, but today they use it for specific purposes, such as searching articles to support their thesis or for communication"*. Donny, running the "B@yonet" Internet café in Yogyakarta, similarly told that: *"We see that students (including high school pupils) now search information in the Internet, not in libraries anymore."*

Table 4
Internet café use (at this visit)

Type of use	Rank Indonesia	Rank Tanzania
E-mail	1	1
Seeking information	2	2
Chatting	3	3
Research	4	4
Reading online news	5	7
Computer games	6	5
Downloading music	7	5
Downloading info and sw for professional use	8	7
Downloading info and sw for amusement	9	10
Doing business	10	11
Other IT-related services	11	9
E-shopping	12	12
Visiting pornographic sites	13	14
Non-computer-related use	14	12
Gambling	15	14

Our findings are in line with those of studies in other parts of Africa. Odero (2003) investigated why students in Pretoria, South Africa, used the Internet café and found that postgraduates tended to use the Internet as an educational resource, while undergraduates used the Internet to chat, listen to music, send free SMS, and other forms of entertainment.

Various use of the Internet among our respondents is depicted in table 4.

At last we looked at barriers to Internet use in Internet cafés (see table 5) and found that users from Indonesia and Tanzania look differently at the obstacles to increased use. Tanzanians rank costs as the most important factor. More than 50% of the respondents would have used Internet more if the price was reduced. Looking at the national differences between general economic level (table 1) and the Internet café fees (table 2), this is easy to understand. The price is two to three times higher in Tanzania than in Indonesia.

While infrastructure quality (access speed) is ranked as obstacle number one in Indonesia, this is only the third most important hindrance in Tanzania. In Indonesia, there are just marginal differences (in score) between the three highest ranks. In Tanzania, costs have much higher score than the rest. We have included some quotations from in-depth interviews in Indonesia to illuminate the cost and infrastructure issues:

Ali, a 30 years old, student in Yogyakarta has used Internet since 2001. He usually visits Internet cafés one hour every day and tells that: *"I do not consider subscribing to the Internet at home, not until I have finished my study and got a job. Because, in Internet cafés it's cheap, all facilities are already available; computers and their peripherals, including headsets, and the place is comfortable. If I wanted to use the Internet at home, I would need phone line, modem, and of course a set of computer. And the cost must be very expensive. Using the Internet in Internet Café is very easy. We need only to come and pay on hourly basis".*

Delia is a 20 years old student at the University of National Development in Yogyakarta. She tells that: *"I access the Internet in Internet cafés and at the university, not at home. Usually I visit the Internet Cafe twice a week and spend 2 hours per visit, on average. The three factors that limit my use of the Internet are costs, spare time and access speed."*

Sheila, another female student in Yogyakarta, feels that bad infrastructure is a problem for her: *"I don't like to open Indonesian websites. It takes too much time to download because of the quality of the servers they use. Because of that, I use English 90% of the time when accessing the Internet and I'm sure I would use the Internet even more if it was equally easy to access the Indonesian websites".*

The significance of amount of useful information is interesting to study closer. This has higher relevance in Indonesia than in Tanzania, where only 6% of the respondents have pointed to this factor as an obstacle to increased use. One explanation could be their English language proficiency (see table 2). From our detailed numbers, we can see that the Indonesian users use English and Bahasa Indonesia equally when accessing the Internet, while the Tanzanians use Kiswahili to a very little degree (less than 20%).

Altough some Indonesian users prefer to use English when they access the Internet, many of them still regard lack of useful information in Indonesian as an obstacle to increased Internet use.

Independent of their language knowledge, the amount of web-based information in their own language is an interesting issue in this connection. Tanzania Ministry of Communications and Transport, (2003:4) states that: *"While there are many Tanzanian websites, most of these are in English ... However, an encouraging phenomenon is that Kiswahili is recognised as being the African language with the greatest web presence".*

Table 5
Factors limiting Internet use

	Rank Indonesia	Rank Tanzania
Access speed	1	3
Costs	2	1
Spare time	3	2
Amount of useful information or services	4	5
Personal skills	5	4

The barriers to Internet use in Internet cafés correspond to a certain degree with some of the general theory we have presented in section 2, above. Access speed is clearly linked to "perceived ease of use" and amount of useful information to "perceived usefulness" in the Technology Acceptance Model (Davis, 1989) and UTAUT (Venkatesh et al., 2003). Kiiski and Pohjola (2002) point to the importance of Internet access cost as an explanation to differences in Internet usage.

CONCLUSIONS

In our study, we show that today Internet cafés are the main access point to computers and to the Internet for people in developing countries like Indonesia and Tanzania. If they are further spread to rural areas, they have the potential to be important tools for bridging the digital divide within such countries and to level the information assymetry.

For a wide range of users, we have showed that Internet cafés are perceived as suitable and economically reasonable sources of information and knowledge. They are, to a large extent, used as arenas for human resource development, through research, information seeking and other professional use. The title of the Abuja-conference is *"Enhancing Human Resource Development through ICT"* and the main objective is *"to explore issues concerned with building a skilled and adaptable workforce in developing countries for the information age"*. In this paper, we have tried to describe the Internet café as a "classroom" for learning, both to use computers and to access information on the global Internet, for ordinary people in developing countries, and thus meet the conference objectives.

Generally, the users are well educated. In Tanzania, however, we find a large portion of users with only elementary educational background. We found that users are willing to spend a high sum of money, on average 10% of their total expenditure on Internet café fees.

Due to English language's dominant position on the world wide web, English language proficiency plays an important role for the users to obtain full benefit from their Internet café use. Tanzanian users derive advantage from the extensive use of English language in the Tanzanian society.

Low infrastructure quality (access speed) is the most important obstacle to increased use among Indonesian users, while costs are considered most important among more than half of the Tanzanian users. All together, access speed, price and spare time are the three highest ranked factors limiting Internet use in Internet cafés.

Sending and receiving electronic mail is the most common use of the Internet among all Internet café users. The Internet café use pattern seems to change over time. New and young users start their 'career' with entertainment and socialising, like chatting and playing games. After a while, more serious use, like information retrieval and research takes over.

As explained in section 4, the research material from Tanzania is still limited. However, this study will in the near future be followed up by a more comprehensive survey from Tanzania. Another limitation in our study is the lack of information about non-users. To make interesting comparisons between users and non-users, this study might be followed up by collecting data from a sample of non-users in the same social and economical contexts.

Another interesting question is to see how Internet cafés can attract new groups of users to develop their competence. In Tanzania, one café was visited regularly by local classes of students (from college and high school). We want to investigate if such "official" use of Internet cafés, or other initiatives, might raise their status and remove culturally based prejudices and obstacles against Internet café use, and thereby increase their importance for the spread of information and competence in rural and information poor areas of developing countries. Mtumwa, a female manager of a small Internet café in Zanzibar, Tanzania, told us: *"People from Zanzibar don't like Internet cafés very much – because you can watch dirty sites. They think that's the only reason for people to use the Internet, but that's not true!"*

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SESSION B1: RESEARCH PAPERS: IT & HR DEVELOPMENT IN THE PUBLIC SECTOR

Challenges and Opportunities of Implementing District-based Health Information System in Ethiopia: A case study from Benishangul-Gumuz Region.

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ABSTRACT

This paper has analyzed the challenges of sustainability and scalability of HIS. The empirical analysis was conducted in a backward and disadvantaged region of Ethiopia. An ongoing process of HISP (Health Information System Program) was addressed and the main challenges in the implementation of sustainable and scalable district-based health information system in the context of Primary Health Care (PHC) sector in Ethiopia were identified. Human resource, infrastructure, and HIS related problems are the main challenges hindering the implementation of sustainable and scalable district-based health information systems in the region.

Key Words: **Health information systems, Sustainability of HIS, Scalability of HIS, HIS in developing countries.**

INTRODUCTION

The delivery and management of health services to deprived communities and regions in developing countries is a truly complex task (Braa, et al 2004). Many developing countries including Ethiopia are experiencing serious problems of providing their populations with adequate Primary Health Care (PHC) services. The 1978 World Health Organization (WHO) conference in Alma Ata, Kazakhstan, concluded PHC should be organized as a decentralized system with a focus on preventive care. The basic tenets are that health services should be offered and managed for and from small demographic and geographic areas to achieve effective communication both with higher and lower levels; be close enough to communities to understand and act upon their problems, and be able to handle the decentralization of resources and decision making. Within this context, a Health Information System (HIS) that captures and uses data at the local level is very crucial to assist in making appropriate healthcare policy at all levels within the type of decentralized systems suggested by WHO. As Braa et al (2004), point out, there is a growing recognition by international agencies, notably the WHO, government authorities, and researchers from different domains including information systems (IS), development theory, and public health that improved HISs can significantly contribute to help address health service delivery problems in the context of developing countries. To successfully achieve this, Amoono-Lartson et.al (1984), suggest "bottom-up", instead of "top-down", planning in order to assess the needs, resources, and opportunities at the community level.

A district-based health system to ensure decentralized management and coordination of health services and advocated as the appropriate level for HIS development (WHO 1988, 1994; Lippeveld et al 2000), has been problematic to achieve in practice (Lippeveld et al 2000). Some of the reasons constituting to this include: the intrinsically centralized and fragmented character of health services, lack of coordination, poor quality and use of information, and the complex organizational context of the health sector (Avgerou and Walsham, 2000). Braa et al (2004) identified two broad themes underlying the unsuccessful attempts with HIS in developing countries. The first concerns the challenge of sustainability to make an IS work, in practice, over time, in a local setting. This involves shaping and adapting the systems to a given context, cultivating local learning process and institutionalizing routines of use that persist over time. They call it the problem of *sustainability*. The second challenge is that of *scalability* which is related to the problem of how to make one, working solution spread to other sites, and be successfully adapted there. Drawing on these ideas this paper was initiated to explore the opportunities and challenges of implementing sustainable and scalable district based HIS in the Ethiopian Public Health Sector context.

The aim of this paper, then, is to explore the challenges and opportunities for implementing sustainable and scalable HISs in the Ethiopian health care system in general and in one remote and disadvantaged region (Benishangul-Gumuz) in particular. Through an empirical analysis of ongoing efforts in the implementation of computer-based district health information system in Ethiopia within the umbrella of HISP-Ethiopia, the paper analyses the case of one disadvantaged region. The paper addresses the following research questions:

- How is the existing HIS functioning in Benishangul-Gumuz region (organizational structure and flow of health information at different levels)?
- What are the challenges and opportunities for developing sustainable and scalable computer-based HIS in Ethiopia in general and in Benishangul-Gumuz region in particular?

Significance of the Paper

Implementation of sustainable and scalable computer-based HIS in the context of developing countries has proven to be problematic due to various reasons. One of the main introducing sustainable and scalable IS in many developing countries is lack of trained and skilled human resources that identifies the impacts, challenges and opportunities of new technologies and deals with those technologies and exploit their potentials to address local problems over time. This paper addresses human resource as one of the main challenges in HIS implementation and how to deal with such challenges in implementing sustainable and scalable HIS in the Ethiopian public Health Care context.

The rest of the paper is organized as follows. In the second section, I describe the theoretical concepts related to sustainability and scalability of HIS. The subsequent section, presents the research approach adopted for this study and data collection and analysis methods. In section four, the case study is presented and in the last section, I present the case analysis, discussion and conclusions.

2. THEORETICAL FRAMEWORK

2.1 Sustainability

The term sustainability can have different meanings, and often implies maintaining something that already exists over time, or is often equated with 'self-sustaining' and 'self-sufficient', which means that no outside support is needed to continue its existence (Reynolds and Stinson, 1993). However, with regard to IS, 'sustainability' means the ability to identify and manage risks threatening the long-term viability of the project (Korpela *et al* 1998). Misund and Høiberg (2003) defined sustainable IT as technology that is capable of being maintained over long span of time independent of a shift in both hardware and software. Sustainability can be seen as a process, starting from the inception of the system, to the various processes around design, development, support and implementation. Sustainability concerns the longevity of these processes and how they co-exist over time, especially once external support is withdrawn (Braa et al 2004). The challenge concerns how the system continues or does not continue to live on within the organization, in a manner in which it effectively supports decision making needs at different levels. Kimaro and Nhampossa (2004) argued that for the sustainability of HIS to be achieved, the interests and resources of all involved actors must be aligned. Actors' interests, knowledge and resources need to be aligned in a network whereby each actor in the network understands its obligations and responsibilities. Such an alignment enables the actors to share common understanding about developing sustainable IT systems so that their individual and joint actions become institutionally shaped meeting the goal of the common network (Kimaro and Nhampossa 2004).

A sustainable IS then needs to meet the needs of the present and be able to keep going over time, when it is institutionalized and the organization is dependent upon it regularly. However, this requires the provision of reliable sources of data and also economic and technical resources. Lack of these resources has contributed to various failures and unsustainable projects (Heeks 2002; Mursu et. al 1999; Korpela et al 2000). Poor infrastructure, lack of information culture and lack of trained manpower further contribute to these problems of unsustainable systems.

Bisbal et al (1999) argued that the sustainability of IT is highly dependent on the system being able to provide reliable and useful information, and the capability of users at all levels to effectively use the system. The absence of participation, capability and motivation of users, coupled with an inflexible system design, makes it difficult for the system to evolve over time and for institutional changes to be incrementally adapted. However, sustainability issues are not only technical (Bjørn-Anderson et al 1990) but also concern the ownership and management of human and financial capabilities which rely on people and their needs and actions. Heeks (2002) has identified a checklist of risks that contributed for unsustainable HIS systems in the context of developing countries. Some of these risks are:

- Formal, quantitative information stored outside the human mind is valued less in developing countries;
- The technological infrastructure (telecommunications, networks, electricity) is more limited and/or older in developing countries;
- Work processes are more contingent in developing countries because of the more politicized and inconstant environment;
- Developing countries have a more limited local skills base in a wide range of skills. This includes IS/ICT skills of systems analysis and design, implementation skills, and operation related skills including computer literacy; and
- Developing country organizations are more hierarchical and more centralized.

Sustainability then depends on both the technical features of the technology including its operational simplicity, flexibility, maintainability, robustness and also the availability and capacity of technical, managerial, institutional, intellectual, socio-political, cultural, and physical infrastructure (Kiggundu, 1989). An absence of a socio-technical focus in favor of a technical approach typically contributes to unsustainablity of HIS in developing countries.

2.2 Scalability

As Braa et al (2004) point out scalability is a prerequisite- not a luxury- for sustainability of local action. Scalability is not about size as such, it is about facilitating the necessary learning processes as "networks of different organizations or work units that can struggle to learn from each other develop designs that meet specific requirements of local conditions" (Elden and Chisholm 1993). As Sahay and Walsham (2004) pointed out, in practical terms while scale refers to the size or scope of something (for example an information system or a process), scaling concerns the process through which that product or process is taken from one setting and expanded in size and scope within that same setting and/or also incorporated within other settings. In the context of information systems (IS), scale then could refer to the scope of an IS (for example, how many users are served), while scaling could imply the expansion of this system in scope and size (for example, making the system accessible to more users or increasing its functionalities).

Scale is also related to the transfer of technology and routines from one site to another, or from a pilot to a full fledged project. Sahay and Walsham (2004) draw upon an information infrastructure (II) perspective to analyze the challenges of scaling, viewing it not merely as a technical problem, but as a socio-technical one involving a heterogeneous network constituted of technology, people, process, and institutional context. Braa and Hedberg (2002) describe how pilot projects initiated through donor funding fail to address scale and sustainability as inter-connected problems. Limited scale projects do often not produce anything useful for managers, who typically need full data coverage from their area of responsibility, and not only for a limited pilot area. As a result, when there is no real useful output produced and after the financial support ends, efforts remain largely unsustainable (Braa and Hedberg, 2002). Problems of scale and scaling are at the heart of the implementation challenge of health information systems in PHCs (Braa et. al., 2004).

In this paper, socio-technical factors that affect the implementation of sustainable and scalable HIS in Ethiopian Public Health Care sector are analyzed. More specifically, concepts of sustainability and scalability are employed in analyzing infrastructure, human resource and HIS related challenges in the process of implementing computer-based HIS in Ethiopian context. The term sustainability is used to analyze socio-technical challenges hindering a system work, in practice, over time in a local setting and in shaping and adapting those systems to adhere to local needs and requirements. The concept of scaling is

used to analyze the challenges of making one, working solution spread to other sites (vertically or horizontally) and be successfully adapted there. The challenges of sustainability and scaling are analyzed based on the empirical evidence and experiences of an on-going project being carried out to implement district-based HIS within the Primary Health care Sector in Ethiopia.

3. RESEARCH APPROACH

This study was conducted in Benishangul-Gumuz region of Ethiopia. The case study was part of an action research initiative within the umbrella of HISP research project, which was started in 1994 by researchers from Norway and the Universities of Western Cape and Cape Town. The aim of HISP is to design, develop, implement and sustain health information systems to support the emerging decentralized health administrative structure in various developing countries. The broader agenda of HISP is to enable local control of health information at district and sub-district levels and thus to empower local users to have greater control of their work processes. This study is based on the author's experiences as an action researcher as part of the HISP team in Ethiopia since 2003.

The study has used mainly a participatory action research approach to introduce interventions along with principles of participation involving health workers. As a data collection method, the study uses participant observation and individual interview of informants including: service providers at clinics, health posts, health centers; Program officers (experts and team leaders); and Heads of health Facilities/institutions. A total of 32 semi-structured interviews were conducted (see table 1 for a summary of respondents). In addition to the individual interview, analysis of documents such as: reporting forms, graphs, tally sheets, copies of monthly reports, and registers was also conducted. The issues related to challenges and opportunities in HIS implementation were analyzed through document assessment and exploration of the efforts being made to implement HISP tools and approaches in the region from June to August, 2004.

Table 1. Distribution of Respondents by Academic Level, Position, and Service Years

Academic Level	Service year				Position			
	1-5	6-10	>15	Total	Service Provider	Expert	Team Leader or Head	Total
Junior Nurse (12+1)	13	0	0	13(41%)	13	0	0	13
Health Assistant (12+1½)	0	5	6	11(34%)	9	1	1	11
Senior Nurse (12+2(3))	1	0	4	5(16%)	0	3	2	5
Health officer (12+4(5))	2	0	1	3(9%)	0	0	3	3
Total	16(50%)	5(16%)	11(34%)	32(100%)	22(69%)	4(13%)	6(19%)	32(101%)*

* Percentages may not add up to exactly to 100 due to rounding effect.

4. CASE STUDY

4.1 The Ethiopian Context

This case study is drawn from Ethiopia, a country situated in the horn of Africa. The total area of the country is around 1.1 million square kilometers and it shares boarders' with Djibouti, Sudan, Eritrea, Kenya and Somalia. Politically, this country uses a federal system, comprising of 9 National Regional States (NRS)[6] and two Administrative states[7]. The regional states as well as the administrative states are

[6] *Tigray, Afar, Amhara, Oromia, Somalia, Benishangul-Gumuz, Southern Nations, Nationalities and Peoples Region (SNNPR), Gambella, and Harari*

further divided into sixty-five zones, five hundred twenty-three 'woredas' and around 10,000 'kebeles'. According to the population projections of the Central Statistical Authority (CSA) based on the 1995 population and housing census, the total population was about 67 million (in 2003 estimates) growing at a rate of 2.7% with more than 85% of its population living in rural areas, making Ethiopia one of the least urbanized countries in the world (HSDP II, 2002).

The public health care system in Ethiopia comprises of the Federal Ministry of Health, Regional Health Bureaus, Zonal Health Departments, and Woreda Health Offices, with their respective health facilities – central referral (specialized) hospitals at the federal level, hospitals at regional, zonal and district levels, and Health Centers, Health Stations, and Health Posts at Woreda levels. The health care system is largely underdeveloped and under resourced and as a result can provide the basic services to only about 60% of the population. Much of the rural population has no access to modern health care, leading to inability of the health care delivery systems to respond both quantitatively and qualitatively to the health needs of the people. The health delivery system is highly centralized; delivered in a fragmented way, relying on vertical programs with limited collaboration between the public and private sectors.

Benishagul Gumuz Regional State is one of the emerging regions of the Federal Democratic Republic of Ethiopia. The Region has 3 zones (Assosa, Metekel, Kamashi) and two special woredas (districts) called Pawi & Maokomo out of a total total of 20 woredas in the region. As per the population projection made by the Central Statistical Authority, the Region's population in 2003 is estimated to be 580,000 out of which over 90% are rural residents. Women of childbearing age make up 24% of the total population while the figure for the under five population is 17%. The Region has high prevalence of communicable disease like malaria, tuberculosis, intestinal parasitosis etc. The infant and under five mortality rate for the region is 97.7/1000 and 197.7/1000 live births respectively (MoH, Health Indicators 2003). The health service coverage is about 55%, and the health service utilization rate is very low. There are two hospitals, seven health centers and 111 health stations & posts. Assosa is the capital of the Region. Around half of the Regions population resides in Assosa Zone and also half of the Regions health facilities are located in this Zone. This case study was conducted in Assosa Zone from June to August 2004. There are seven woredas in the Zone, out of which the study included four. These were: Assosa, Bambasi (45Kms from Assosa), Menge (56Kms), and Sherkole (100Kms) Woredas.

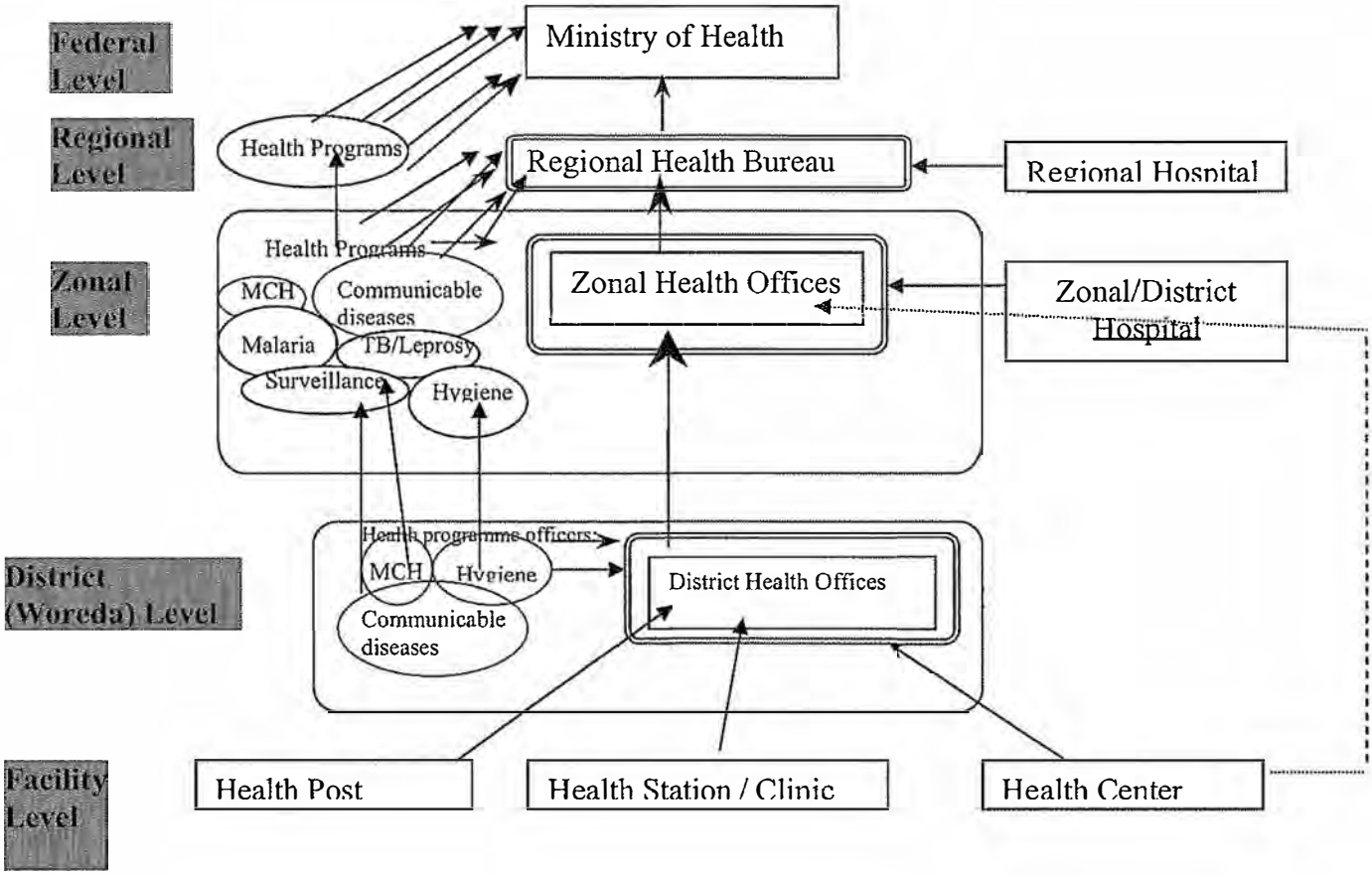
Figure 1: Map of Benishangul-Gumuz Region

[7] Addis Ababa city administration and *DireDawa* council

4.2 Health System Structure and the Health Information Systems

The health structure is organized into 5 different levels comprising of the Federal Ministry of Health, Regional Health Bureau, Zonal Health Departments, and Woreda Health Offices, with their respective health facilities – central referral (specialized) hospitals at the federal level, hospitals at regional, zonal and district levels, and Health Centers, Health Stations, and Health Posts at Woreda levels (see Figure 2 for schematic sketch of the HIS structure).

Figure 2: Health Information Flow in Benishangul Gumuz Regional State



4.3 Situational Analysis: Case Findings

The case findings are based on the situational analysis on the health structure, flows of health information, existing physical and ICT infrastructure, and availability of skilled manpower. The study was conducted by HISP team members (including the author) for the period of three months from June to August 2004 in Benishangul-Gumuz region.

4.3.1 Infrastructure

The infrastructure situation, both physical and ICT related found to be very poor even compared to other regions in the country. All facilities visited by the researcher except Assosa Hospital, were not equipped with computers. Even at the woreda health offices computers were not available and all data aggregation tasks are performed manually. At Zonal level, from the three zones it was only at Assosa Zone Health Office that computer is available. Even this computer is used by the typist for only secretarial purposes. It is not utilized for health information management (data entry, analysis, report generation etc) activities. Most of the respondents interviewed acknowledged the need for a computer especially for data handling, analysis and report generation.

The region has very poor transport, road, postal and telecommunication infrastructure. For example, except Assosa zone, the other two zones (Metekel and Kanmashi) use radio to communicate with the regional health bureau. It is only in Assosa (the capital of the region) that one can find telecommunication services such as telephone, fax, telex and Internet. Regarding availability of electricity, all health facilities and health offices at woreda and zonal levels (except those in Assossa town) do not have access to electricity. The existing Infrastructure (both physical and computer-based) in the region is so weak. In such situations, introducing computer-based health information systems and making them sustainable and scaling up to other sites will be a challenging task ahead of HISP.

4.3.2 Existing HIS

The situation analysis of the existing HIS in Benishangul-Gumuz region revealed that it is primarily top-down, implying that while planning and implementation of health systems was done at the level of the central ministry of health (MoH), health data is collected using paper form at the local community level and sent up to the region and ministry. Health facilities report directly to woredas (districts). At this level, health data coming from different health units within the district is aggregated and sent to the Zonal health office. At the zonal level, data collected from the different districts within the zone will be summarized and reported to the region. The region will then aggregate and make some analysis on the data collected from all the zones within the region and report it to the national level (MoH) for overall nationwide data integration and analysis.

A large part of the data collected by health workers at facility level, in some cases almost all of it, was transmitted to the higher level with out being analyzed and used locally. Feedback from MoH and regional health bureau to the local levels is limited. At all the levels visited (facility level, woreda and zonal health office level), all the respondents said that they have never received feed back from the higher level to which they send reports on monthly basis. The multiplicity of health programs and their lack of integration constitute to uncoordinated data flows and reporting routines, and also to a major impediment on managerial activities.

All respondents interviewed reported the use of different forms for the various health programs including: MCH (includes FP, CDD, ARI, GM, Delivery, ANC), EPI, Environmental sanitation/hygiene, Health Education, HIV/AIDS, STI, TB/Leprosy, IDSR (surveillance), Malaria, Morbidity, Laboratory. Most of the respondents complained about excessiveness of data and lack of clarity on reporting forms.

A majority of health workers work time is spent on data collection (filling registers) and reporting to higher levels, which when conceived with their health provision work, resulted in a very heavy overall workload. Average time required for the service providers to fill registers etc. was 4:30 hours of daily work. The range identified was 1-8 hours. Health workers, especially those serving large population segments worked often more than 8 hours a day. Average time taken for preparing the monthly report i.e. summing up and filling the forms was 1.5 days (range from 3 hours to 4 days) for the service providers, 2.5 days (range 1-3 days) for the experts and 2.3 days (range 1-5 days) for the team leaders or heads.

With respect to the importance of the data they collected to their everyday work, most respondents believed that data collection was important. But, they consider the data as irrelevant for their everyday work practices. The respondents saw data collection as a task conducted just for reporting to the higher level, and they collected data because they were expected to do so.

Respondents indicated that reports do not reach to higher levels at the right time to make appropriate action and decision. The main reasons cited for this delay are: lack of transportation, shortage of manpower, and lack of reporting forms.

The challenges on the existing HIS structure and flows of health information system can be summarized as follows:

- The existing HIS structure is primarily top-down with no analysis and use of information locally. Reporting to higher levels is top priority.
- In the existing health system, health data is not maintained in a systematic way on health facility basis. The existing HIS is designed to support higher levels in the evaluation of vertical programs which hinders local participation and local use of information at facility, woreda, and zonal levels. It is organized based on the needs of the vertical health programs at the central level and not on the needs of health units at the local level. The system, therefore, doesn't allow local analysis and use of data and information for local action and decision.
- The vertical structure of the reporting system and the way data is aggregated at Woreda (district) level makes it difficult to keep, maintain and analyze data to support district management. Inadequate organization and management (i.e., vertical programs and centralized planning) is the major underlying factor contributing to the inadequate distribution of services and mediocre performance of health services to the region.
- The feedback routines from Regional health bureau to Zones and then to woredas and from woredas to health facility are poor. This resulted to delayed reporting and incomplete data from the lower level.

4.3.3 Human Resource

Respondents indicated that they lack the necessary skills for data handling and management. The lack of skills and knowledge for data handling was due to lack of training and support in this regard. All the health workers interviewed reported that they had never been given any training on health information and they had not been provided with any guidelines or protocols on data collection, processing, analysis and its transmission. For example, asked about their knowledge of health indicators, ninety four percent of the respondents didn't know the meaning of 'indicators'. It was only two health workers (6%) at the zonal health office that reported they know what the term 'indicators' meant. Asked about their computer literacy, none of the respondents have replied as they have computer literacy. Most of them even don't have touched computers in their lifetime. Implementing computer-based HIS for such users who doesn't have any know how about the technology and ensuring sustainability of that system is a challenge in HISP initiatives in the region. Scaling of such systems from the pilot sites to other zones and woredas is also a challenging task.

5. CASE ANALYSIS AND DICUSSION: THE CHALLENGES AND OPPORTUNITIES FOR HISP INITIATIVE

The case analysis is based on the situational analysis and experiences of an on-going project being undertaken to implement computer-based health information system in Benishangul-Gumuz region. The case analysis addresses the implications of the findings on the challenges of implementing district-based HIS in the region. More specifically, challenges of sustainability and scalability in implementing computer-based HIS are explicitly discussed. Besides, issues related to how HISP is dealing to tackle those challenges the implication of those challenges in implementing sustainable and scalable HIS in the region are discussed. A variety of constraints and challenges have been identified ranging from a vertical and top-down health structure, inadequate infrastructure and manpower shortages, to a culture that does not yet value the efficient use of information. Questions related to how the existing HISP approaches and efforts are adapted to existing HIS structures, how local interventions are made sustainable through institutionalization, and how local interventions are scaled to other sites (Zones and woredas in the region or to other regions in the country) are central challenges of implementing district-based HIS in the region. The HISP project aims to create local capacity for data handling and processing in order to support informed decision processes at the national, intermediate, and peripheral levels

HISP-Ethiopia was initially introduced in Ethiopia to address the existing problems of HIS in collecting, analyzing, interpreting, and reporting health data and to investigate and explore the potential that ICTs can provide to improve the way people work by increasing efficiency, quality of data and access to stored information and to reduce the overall costs of overall health care delivery system. The project is engaged at all levels and aspects to enable effective implementation of various data collection standards, their storage, processing, analysis and use.

In Ethiopia, HISP aims to design, develop and implement sustainable and scalable HIS at the woreda (district), zonal and regional levels. Through the local experience, HISP-Ethiopia will also contribute to the broader development of

the HISP global network. HISP seeks to introduce computers at the district (woreda) levels as contrasted to the existing focus of computerization at regional and national levels. By placing computers at the district and through training of district staff, HISP seeks to redress the current imbalance in focus and encourage the local analysis and use of information to support health care in peripheral and remote areas.

Some of the tasks performed so far by HISP in Benishangul-Gumuz region are:
Situational analysis on existing HIS structure, flow of health information, infrastructure and identifying the information needs of health workers and managers;
The formation of HIS review teams comprising of health workers, managers (from woreda, Zone and regional offices) and IS professionals from HISP to ensure partnership and participation among health workers and IS professionals;
Development of essential data sets and standards for primary health care data for the region;
DHIS database implementation and customization that supports the storage, analysis and dissemination of health data at different levels. The implementation of DHIS software was undertaken at the regional health bureau and Assosa zone health department in Assosa town. Due to lack of computers and other facilities the software is not yet set up at Woreda levels in the region.
Ensure partnership and collaboration among HISP teams across the different pilot regions in Ethiopia. This includes exchange of software, manpower, training tools and materials, essential data sets and standards...etc.
The following sub-sections present analysis of the different socio-technical challenges encountered in the process of implementing computer-based HIS in the region and their implications on making those systems sustainable and scalable. HISP approaches and strategies in dealing with those challenges and how to address the issues of sustainability and scalability of HIS in the region are discussed.

5.1 Human resource Challenges

Implementation and use of HIS in developing countries is often unsustainable due to lack of appropriate human resources to operate the system and to continue its development over time. These challenges are also evident in Benishangul-Gumuz region, including lack of trained and qualified manpower, inadequate computer literacy, heavy workload of health personnel, and conflict between providing care and administration of routine health data. According to Heeks (2002), one of the factors that contributes for unsustainable HIS in developing countries is that developing countries have a more limited local skills base in a wide range of skills. This includes IS/ICT skills of systems analysis and design, implementation skills, and operation related skills including computer literacy. To deal with human resource related challenge and to ensure the sustainability of the system in the region, HISP is trying to address these problems in different ways. Some of the approaches used by HISP to deal with manpower problems are presented as follows:
Hiring of full time trainer and facilitator: In dealing with the problem of computer literacy among health workers and managers, HISP has employed a full-time facilitator in all the pilot regions. Each regional facilitator is responsible in trouble shooting and giving training to health workers and managers about the basics of computer hardware, software, operating systems and basic Ms-office application packages (Ms-word, Ms-Eexel, Ms-Access) and of DHIS software. The facilitator is also responsible to customize DHIS software to fit to local needs and requirements.
Involving medical doctors in the implementation program: In order to create close partnership and to ensure sustainability of the system being implemented, HISP promotes the involvement of medical doctors along with IS professionals in the implementation of DHIS software. This will help both parties to assist each other and gives opportunity for medical doctors to improve their IT skills and IS professionals to improve their knowledge in the public health domain.
Linking implementation with education and research: In the Ethiopian context, there are doctoral and master students from Addis Ababa University, Department of Informatics who are studying at the University of Oslo (Department of Informatics) and who are writing their thesis on problems particularly relevant to the health departments at different regions of the country. Currently, the students are closely working with health workers and managers at different levels and conduct software customization, implementation of DHIS software, user training on the basic IT skills and the software...etc. This arrangement contributes to ensure sustainability of the district-based health information system being implemented by HISP by creating partnership and collaboration among the regional health departments, the informatics department and HISP.

5.2 Infrastructure Challenges

As Avgerou and Walsham (2000) indicated, key impediments to developing scalable systems arise from resource constraints and lack of political will. Although there is a good political will in transforming and improving the existing paper-based health information system in Benishangul-Gumuz region, lack of resources and poor infrastructure are the major impediments for the implementation of a bottom-up district-based health information system using HISP

approaches and tools. As Heeks (2002) pointed out lack of technological infrastructure (telecommunications, networks, and electricity) is one factor that contributes for unsustainable systems in developing countries. In Benishangul-Gumuz region, the existing Infrastructure (both physical and technological) in the region is so weak. This situation has a negative impact in making the new system sustainable and work, in practice, over time, in a local setting.

The primary challenges in relation to infrastructure of the region are: lack of computers electricity and telecommunication infrastructure; non existence of roads and lack of vehicles at woreda and zonal health offices; and poor office and work facilities. Let alone the districts and health facilities, two of the three zones (Metekel and Kemashi) in the region are isolated from the main road and can't be reached by vehicles during rainy seasons. This isolation has seriously affected all aspects of socio-economic development processes including provision of improved health care to the remote and isolated communities. The existing poor technical and physical infrastructure in the region (particularly lack of electricity and public transport in the two zones of the region) has a negative impact in ensuring sustainability of the new system being implemented in the region and in scaling-up software, experiences and knowledge acquired in the pilot zone to other districts and zones with in the region.

Although fully addressing all the specified infrastructure related problems is beyond the capacity of HISP, the following approaches are used to tackle infrastructure related problems in the region:
HISP has introduced free open source code software (DHIS) which is developed using MS-Access database system. The software is easy to use and can be implemented at lower facility and district levels. Besides it doesn't require computers with high memory capacity and processing speed. Attempts are being made to acquire some used computers from some international organizations (WHO, UNICEF, USAID) working locally to alleviate the problem of computers in the region.
Data entry can be done over a few days once in a month when electricity is there.
By consolidating and integrating the data forms the number of reports to be generated could be reduced. This can help health workers to compile and send the reports on time to higher levels using the existing means of communication.

5.3 Dealing with the existing HIS structure
The major challenges of the existing HIS in the region are: vertical structure and top-down approach; lack of integration among different programs; lack of feedback information, inconsistency of items and lack of clarity in reporting formats; lack of guidelines on health information collection, analysis and reporting; delayed reporting; and reporting of incomplete data. Another important challenge in implementing sustainable and scalable HIS in the region is the existing culture of information, which doesn't value information as important resource for action and decision making by health workers at different levels. These challenges have a negative impact in making the new systems sustainable and in scaling experiences and knowledge to other sites in the region and to other regions in the country. The HISP approach and philosophy of user participation and involvement in all phases of systems development would solve most of the existing HIS problems of the region. As Braa et al (2004) pointed out; one of the important issues that contributes for sustainability of IS is shaping and adapting the systems to a given context, cultivating local learning process and institutionalizing routines of use that persist over time. In dealing with the existing HIS related challenges in the region, the following tasks are being undertaken by HISP:
Bottom-up, incremental and participatory approach: HISP follows flexible, incremental, and scalable approaches to systems development. Such an approach allows for user participation, learning and institutional capacity to be developed through the process of developing, implementing and using the systems. HISPs bottom-up and incremental approach empowers local users to use information for local action and decision making. For example, the process of developing the Essential Data Sets (ESD) for Benishangul-Gumuz region was conducted by using participatory approaches and involving health workers and mangers at different levels of the hierarchy. This approach contributes to ensure the sustainability of the new system by involving all stakeholders at different levels in the process of transforming the old system and introducing a new system. Scaling of whatever knowledge and experience obtained in the pilot sites will be also easier.

Emphasizing the importance of local use of information: HISP builds an information culture among health workers with new understandings and perceptions towards information, and social values of behavior related to collection, reporting and use of information. For example a two days workshop to create awareness on the importance of health information was given for health workers and managers at different levels. As Heeks (2002) indicated, limited local skills base in a wide range of skills contributes to failure and unsustainable IS in developing countries. Thus, HISP's approach of giving trainings and creating awareness on information use behavior through workshops and conferences is crucial to change the attitude and knowledge of health workers and managers towards health information and to make the new system more sustainable in the region.

Developing essential data sets and standards: HISP addresses the problem of integration and standardization among vertical programs through bottom-up processes of standardization and IS development that emphasizes local control of information and computing resources. The development of standardized EDS for Benishangul-Gumuz region using a bottom-up process addresses the problems of inconsistency and integration among the different health programs and would contribute in the development of sustainable health information system in the region. The ESD developed for the region could also be scaled up to other pilot regions in the country.

Spread of tools, expertise, experiences and knowledge across regions: HISP believes in both vertical (with in the region) and horizontal (across the regions) spread of ideas, tools, artifacts, experiences and knowledge across different levels in the same region and between regions. For example, the EDS developed for Addis has been shared among different HISP pilot regions as a baseline document.

CONCLUSION

In this paper, I have discussed the challenges of scalability and sustainability more generally with respect to HIS implementation in developing countries context. These challenges also exist in Benishangul-Gumuz region and have been revealed through my situation analysis. I have distinguished some of the challenges and opportunities related to an ongoing HISP initiative in the Ethiopian context. Some of the major challenges that hinder the implementation of district-based health information system are: vertical and top-down health structure, inadequate infrastructure, lack of appropriate manpower, and a culture that does not yet value the efficient use of information. These challenges affect the scalability and sustainability of the HIS being implemented in the region. In dealing with these challenges, HISP has introduced different approaches and strategies. Challenges of sustainability is being tackled by developing systems using bottom-up, incremental and participatory approaches, user training, by establishing partnership among different stakeholders (such as health workers, managers, researchers, and IT professionals), by emphasizing the importance of local use of information, and by developing essential data sets and standard reports forms. The challenges of scale are tackled by linking HIS implementation with education and research, allowing different standards at different levels with in the same region and across regions, and by allowing the spread of ideas, tools, methods, experiences and knowledge across different nodes. In the analysis of sustainable and scalable interventions, it was noted that getting local involvement of health workers and mangers in the development and implementation process and self-sufficient learning processes to share experiences across different regions are crucial factors for sustainability.

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Enhancing Managerial Quality in Government ICT Projects: Lessons from Gujarat

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ABSTRACT

Investment in human resource development is recognised as one of the most fundamental prerequisites for socio-economic development and the importance of improving managerial quality in government has recently been emphasised by international agencies. In this paper, we draw on over ten years of fieldwork in Gujarat, India during which time the author has been studying developments in IT usage for district level planning and administration. Our findings indicate that prominent components of managerial quality need to be nurtured within the district administration in order for decentralised ICT projects to make any noticeable impact on the performance of development programmes.

INTRODUCTION

From the 1980s onwards, the advent of microcomputers combined with the proliferation of computer software to support information processing for planning has fostered the emergence of decentralised information systems and several decentralised applications were undertaken in developing countries at this time. In India, district planning was introduced with the National Informatics Centre placing microcomputers in each of the 439 districts of the country. In Africa, the Resource Management for Rural Development Project in Kenya introduced microcomputers in the districts. In South-East Asia, Malaysia began to extend its Integrated Development Project Information System to the districts around this time (Madon, 1993). The variety of difficulties that hindered the success of these projects has been well-documented. In particular, many writers identified that the single most neglected aspect of systems implementation was related to lack of attention paid to human resource development and management (Nabarro *et al.,* 1989, Odedra, 1990).

International agencies have placed increasing importance on human resource development and capacity building as a precursor for development (UNDP, 2001). The World Development Report 1998/9 proposes that two types of capacity building are critical for developing countries. The first type of capacity building relates to the need for technical knowledge or know-how. Examples include knowledge about rural development issues such as irrigation methods or agricultural cultivation. Developing countries have less of such technical knowledge than industrial countries and higher income countries continue to innovate and discover new models to implement. One can argue that even greater than the technical knowledge gap is the gap in the capacity to create knowledge. At the same time, with the cost of communication having decreased, transferring knowledge is cheaper. There are also increasing examples of developing countries establishing scientific and research institutes focusing on the development of expertise is locally relevant technical know-how such as herbal medicine, tropical crop cultivation, etc.

Even if technical knowledge capacity building is improving, another type of capacity building is lacking. This gap relates to knowledge about how to improve performance in development endeavours such as the setting of performance standards for measuring the attainment of development goals, the monitoring of efficiency within the functioning of institutions, the establishment of systems of managerial and political accountability of those engaged in the delivery of programmes, and the constant need to nurture new and innovative ways of combating complex development problems (World Bank, 1999). The World Development Report refers to this as a gap in knowledge about quality attributes of development programmes.

The scope of this paper is to unpack the dimensions of this gap in knowledge about the management of development programmes. The programme we consider is the Integrated Rural Development Programme (IRDP) implemented throughout India, and its sequel the Small Group Savings Scheme (SGSY). We are interested in investigating the effects of increasing automation and computerisation in government departments on this knowledge gap. In the next section, we draw on the work of recent writers in organisational studies to

gain a better understanding of the different dimensions of managerial quality in government. We relate these dimensions to experiments of IT diffusion in the Indian context. In Section 3, we present our case study findings of the implementation of the IRDP and SGSY in the western state of Gujarat. Section 4 attempts an analysis of the findings in terms of the critical dimensions of managerial quality presented earlier in order to provide an explanation for the performance of this scheme to date. Finally, we provide some policy implications of our analysis and point to further analysis which can be undertaken.

Methodology

The research approach adopted throughout can broadly be classified as an interpretive case study (Walsham, 1993). The author has selected a longitudinal research design in order to trace the dynamics and long-term implications of ICT implementation for district-level planning in the Indian context. The author commenced her study of district-level computerisation in Gujarat in 1989 and until 1992, the study was part of her doctoral thesis. During this period, fieldwork was organised at roughly nine-month intervals and involved face-to-face semi-structured interviews, participant observation, attendance of meetings and made use of various secondary sources. Following the completion of the thesis, the author continued to work on funded research projects studying the impact of ICT and e-governance initiatives in Gujarat on administrative reform and rural development. The case study description in Section 3 will describe the data collection methods in more detail.

ENHANCING MANAGERIAL QUALITY IN GOVERNMENT

A review of recent organisational literature reveals that the quality of sustainable human resources both at the level of individual offices and for a programme as a whole is critical for public sector projects. Vigoda & Vural (2003) emphasise four prominent components of managerial quality in government.

First, human quality and professionalism. Many studies have emphasised that an efficient, skilful, professional and committed public service support government functioning (Hart & Grant, 1989; Vigoda, 2000). For this to exist, these authors have indicated that staff needs an adequate and supportive work environment and that it is the duty of senior management to provide a vision and to suggest ways of translating this vision into action. A good example where such a vision for improved professionalism in Government exists is in Andhra Pradesh. Driven by the visionary zeal and progressive will of the ex-Chief Minister, Chandra Babu Naidu, Andhra Pradesh has made tremendous strides in implementing various e-government initiatives over the last five to seven years and has reached a state of technological maturity. Various departments have launched complex organizational change initiatives and have improved efficiency by replacing all paperwork with electronic file transfers.

A second component of managerial quality in government is acceptance of transparency and accountability as leading values of staff. Transparency and accountability within the administration provide an indication of willingness of managerial staff to be self-critical and to improve existing work procedures (Halachmi, 2002). A recent initiative aimed at promoting political accountability through transparency of data in Bangalore is worthy of mention. The PROOF initiative spearheaded by the commenced as a 10-month campaign in July 2002 by four Bangalore NGOs (PROOF, 2002). PROOF aims to put in place a system of government performance reporting along the lines of the private sector using US accounts and standards methodologies. A PROOF document is produced every quarter providing citizens an opportunity to become fully engaged in budget formulation and assessment through a series of bilingual training sessions organized by the NGO Janaagraha since October 2002. This data then gives citizens residing in a particular ward an opportunity to discuss and debate different aspects related to the implementation of works carried out by the BCC in that ward such as quality, timeliness, utility, etc. (Janaagraha, 2002; Madon, 2003b).

A third component of managerial quality in government is the extent of commitment by organisational members to morality and ethics as desirable codes of behaviour (Suzuki, 1995; Lui & Cooper, 1997). These writers argue that while every bureaucracy is characterised by a formal set of regulations and laws, their implementation is dictated by the way in which managers interpret them. With the FRIENDS e-services project in Kerala, government departments were initially sceptical of the project. This is perhaps not surprising for a state culture in which the militant unions feared job losses. An important element of the project was the assurance given to employees that they would not lose their jobs and the offering of rewards to public servants who joined as service officers. The strategy adopted by the state government was to send home the message that the individuals selected for FRIENDS have a very special responsibility on them – that of taking the state to the next

millennium. Staff was clearly told about the importance of the project in terms of how it would benefit the citizen and how each one of them would make a difference to the lives of many fellow citizens. Moreover, the working environment and ambience in the FRIENDS centres was much superior to their normal work surroundings. The point was driven home that this ambience had been created not just to impress customers, but because the staff themselves were special. As a consequence, self-esteem of the workers went up substantially as they could perceive themselves as professionals working in a nice environment (Madon, 2003a).

A final component of managerial quality in government refers to innovation and creativity of personnel. Traditionally, public sector organisations are viewed as uncreative and stagnant bureaucracies and managerial innovation and creativity serve as an essential requirement for renewal, development and continuous advancement towards improved effectiveness of government programmes. An example of innovation in governance activity is the experience of the Bangalore Agenda Task Force (BATF). In 1999, the state government of Karnataka appointed a task force to improve the city of Bangalore. The BATF is a private sector partnership with the government, which has resulted in the creation of a platform for citizen-government interactions. Seven stakeholders including the head of the city corporation, the police, the Bangalore Development Authority and the water supply department met the citizens at bi-annual summits from 2000 until 2002. At the summits, the heads of these organisations declared their plans for the next 6 months and presented their achievements for the previous six months. This mechanism worked in encouraging government agencies to set realistic goals and to deliver on time (i4d, 2003).

The enhancement of managerial quality in government is vital for the effective usage of funds for planning and administration. In this section, we have looked at the components of efficiency and professionalism of employees, transparency and accountability, morale and work ethics, and innovation spirit among government employees taking examples from India of IT projects in government where these components are manifest and have resulted in effective results. Taken together these four components can be considered critical for interventions that seek to reform the public sector through computerisation of planning and administration functions. In the next section, we present the findings from our longitudinal study of the impact of computerisation on the implementation of rural development programmes in Gujarat.

CASE STUDY: RURAL DEVELOPMENT PLANNING SYSTEMS IN GUJARAT

The case reported builds on an in-depth study of computerisation in the district rural development agencies of Gujarat. The Computerised Rural Information Systems Project (CRISP) was launched in 1986 for the purpose of encouraging decentralised monitoring and planning of the IRDP which was a major Government of India initiative launched in 1978 to enable the rural poor to earn a minimum income to meet their basic requirements. Our earlier study provided insights into the difficulties and challenges encountered in implementing technological change in the context of development administration and found that the implementation of CRISP was influenced by a web of socio-economic, political and cultural factors in the focal and wider context. Two main barriers that were identified in Madon's earlier study which resulted in minimal usage of CRISP between 1987 and 1990. First, the CRISP reporting proformae did not correspond to the monthly reports that had to be prepared by the DRDAs as the system had been designed without adequate consultation with the state government and district-level users. The reports could therefore not be prepared using the CRISP system and the DRDAs reverted to the manual system of reporting. Moreover, monitoring remained exclusively in terms of targets and achievements in terms of money allocations and beneficiaries assisted which was hardly likely to have any substantial impact of the way in which the IRDP was planned, implemented and monitored. The mismatch between the formal GOI guidelines and informal practice was highlighted in an earlier paper by Madon (1992). Second, efforts to computerise during this period were hampered by inadequate attention to technical support and to training the DRDA staff, the majority of whom had never seen a computer and were not conversant in English. Moreover, only one or two officers were required to input raw data from the BPL survey into the CRISP system amounting to around 300,000 records per district. The frequent transfer of these staff and the Director of the DRDA often led to the problem of lack of continuity in computerisation efforts.

One of the main reasons for the problems encountered during the period 1987 to 1990 was that the district DRDAs had no flexibility to tailor the design and management of the CRISP system according to local requirements. By 1990, concern was expressed by the government regarding non-utilisation of CRISP and the Gujarat Government decided to promote and train DRDA users in databases, spreadsheets and word processing

incurring an expenditure of 10-15 crores on training, hardware and software with a specific focus on local language needs. Interest increased among the DRDA staff and a variety of interesting improvisations occurred regarding usage and management of the computer systems, and in terms of introducing new work procedures in the DRDA. In April 1993, we conducted a survey of DRDA usage in 12 district DRDA offices in Gujarat ranking districts according to three dimensions of interest: the extent of local applications that had been generated for reporting and analysis; local management of the IT resources in terms of training, support and data entry operators; and general enthusiasm for IT. We explain these dimensions below:

Extent of local applications:
This dimension refers to the extent of effort exerted in the DRDA towards the design and development of applications for reporting or analysis. This effort may be in terms of the design and development of spreadsheets for routine monthly reporting of rural development programmes, word processing applications to handle administration and letter-writing, databases for payroll functions, etc. We were interested also in noting the extent to which DRDAs were beginning to use the computer for analytical applications such as for sorting beneficiary data according to income.

Local management of IT resource:
This dimension refers to the extent to which DRDAs were proactive in managing their IT resource from their own resources. This refers to locating trainers from within the district to train staff, identifying local support staff perhaps at engineering colleges to service the equipment rather than relying on support from the state government, and hiring local data entry operators.

General enthusiasm for IT:
This dimension refers to the extent to which DRDA staff appeared enthusiastic about IT rather than viewing it as an extra burden imposed upon them.

Evidence for the rankings was collected using semi-structured interviews rather than through questionnaire in order to enable respondents to introduce variations in their choice of answer. Some data came from secondary sources such as from DRDA reports and memoranda. The author prepared interview guidelines for staff of various ranks within the DRDA and found that in many cases, data collection required a certain rapport to be built between the researcher and the respondent. It was feared that without this, the required openness of discussion would not be achieved. The researcher therefore required repeated meetings with respondents to discuss issues.

Each district was ranked on a 3-point scale of low, medium or high with regards to each of these dimensions on a comparative basis (see Table 1). Our main finding from this survey was that in general usage correlated well with local application development and local management of the IT resource. Another important result from the study was that usage of IT for routine data processing was a necessary precondition for more analytical applications. Several recommendations were made at the time to Gujarat Government regarding how to build and sustain local initiative with strong state-level support.

Between September 1996 and July 1997, we extended our study to compare usage of CRISP in Gujarat with district DRDAs in Karnataka using the same methodology and dimensions of interest (Madon & Bhatnagar, 2000). We wanted to understand whether variability in the structure of the district planning apparatus in the two states significantly affected take up of information technology. Our findings revealed that Gujarat far exceeded Karnataka in terms of the development of local applications within DRDAs. In Karnataka, DRDAs were far more reliant on the NIC for data entry, support and applications development such that staff in the Zilla Parishad had little direct contact with the computer and far less inclination to improvise in the usage of IT. In Gujarat, by contrast, DRDA staff had a far greater impetus to direct IT according to local needs and to take charge of local management of IT. They were therefore more eager to experiment in the usage of IT for report generation and simple analyses.

In August 2003 we conducted a further study of IT usage in the DRDAs of Gujarat using the same methodology and dimensions of interest as earlier. Despite changes in the macro environment within which DRDA computerization efforts were taking place, these dimensions remained critical in supporting a key generic finding from our preliminary study: that acceptance and usage of ICT derive from local administrators having the flexibility to direct the technology towards their own requirements. We were interested to discover what

progress had been made over the 6-year period in terms of this key finding. The aim of the recent study is not so much to compare usage in individual district DRDAs, but to test our main findings that usage correlates with localized reporting and analysis, and with local management of IT. We found that the progress made in terms of improvements in the effectiveness of rural development planning and administration had been lost and that many of the DRDAs had regressed to the situation that had existed in the early 1990s on non-usage of underutilization of the IT resource. Our results signaled a drastic deterioration in the performance of DRDAs from the earlier situation in 1993 when many DRDAs were beginning to use the computer not only for generating local reports, but also for simply analysis. During our 2003/2004 visit, we found that although DRDAs were relatively well-equipped in terms of infrastructure with between 6 and 14 machines, most had only one computer operator in charge of using the machines and that there were hardly any examples of local management in terms of support and training. In general, usage, local management and general enthusiasm for the IT resource were low.

ANALYSIS

In this section, we try to provide an explanation for the evolution of district-level computerisation in Gujarat. We do this by linking our long experience from the field with the analytical constructs we had introduced earlier related to important dimensions of managerial quality in government.

The first dimension of managerial quality we had discussed earlier related to merit and professionalism amongst civil servants and the provision of a vision by senior bureaucrats and policy-makers. One of the major features of technology policy in the mid-1980s in India was the active pursuit of computer applications, which had a catalytic effect on development (Madon, 1993). A massive programme of computerisation was launched in the public sector and several attempts were made at the time by central government to develop computer applications for planning and monitoring of rural development programmes. A large amount of funds were allocated to DRDAs, which were constituted as main agencies for the efficient implementation of anti-poverty programmes. The development officers and extension workers involved in the execution of these programmes were considered an important human resource charged with the responsibility of the upliftment of below poverty line people. Over the course of the 1990s, however, the earlier drive towards directing information technology applications for improving the efficiency and effectiveness of rural development programmes gradually disappeared. DRDA agencies began to suffer cutbacks in terms of financial allocation and staff resources. A new ethos, that of front-end e-government applications, took over and policy soon began to be directed towards the implementation of applications which had a high level of public interface. For example, some of the current projects within the Gujarat Government's E-Government portfolio include introducing multi-purpose ID cards for citizens to be used to obtain a variety of services and establishing a Government of Gujarat web portal to provide a common gateway to all public, private and voluntary sector data. Such applications are facilitated by the GSWAN high-speed connectivity, which has been established throughout the state to district level. Another e-government application currently being piloted in one district in the state is Mahiti Shakti – a programme which has set up 80 multi-purpose technology centres in Panchmahals district in order to provide information and assistance to citizens regarding government schemes. Each centre, owned by a local entrepreneur, provides a useful service to citizens enabling them to speedily obtain a print out of government application forms for a fee of Rs. 20 per form without having to visit individual government departments for these forms (for example an application form to start a saloon in the locality, or an application form to obtain a ration card).

The second dimension of managerial quality related to the extent to which transparency and accountability were regarded as leading values of staff. In the late 1980s and early 1990s, the CRISP initiative was not accepted by users for a variety of reasons. Users had been locked into the rigid system in which they had no sense of ownership of the data they were generating and no incentive to be accountable to the population of below poverty line people they were implementing programmes for. Since the 1990s, our study has revealed patterns of change as increased transparency of data regarding the IRDP and its functionings begun to serve as an occasion for administrators to reflect on existing inefficiencies in the system. Users have been inclined to develop useful applications because they begun to perceive that they have some control over their use. Our results showed that acceptance and usage of the technology appear to derive from local administrators having the flexibility to direct the technology towards their own requirements and having the budget to manage their own IT resource. However, since the late 1990s, there is considerably less transparency of data regarding the execution of anti-poverty programmes and reductions have been made in the district administration budget.

An important factor for reduced transparency and accountability amongst DRDA staff has been the restructuring of the IRDP and its ancillary programmes into a new scheme called the Small Group Savings Yojana[8] (SGSY). This scheme is conceptually far more complex than the IRDP as its focus is not the individual household, but the generation of micro-enterprise amongst self-help group. These groups are provided with six months training on how to organise themselves, discuss issues, mobilise credit, open an account, save regularly, earn interest and distribute profits among the group. An important element of this scheme is that voluntary groups and non-government organisations work closely with communities at the grassroots level. At the present time, there are approximately 80,000 groups formed in the state with each DRDA responsible for about 3000-5000 groups. The monitoring of SGSY is a complex process, which requires the regular collection and analysis of qualitative indicators regarding the formation of groups and their sustenance. Senior level rural development officers at the state government level as well as by district DRDA directors and other staff acknowledge this. However, given the sheer complexity of the scheme and lack of resources to devote towards its implementation, planning and implementation for the SGSY is currently opaque and occurs based on data which bears little relevance to the reality of its functioning at grassroots level. This provides little opportunity for officers to held accountable for the functioning of a scheme as important as the SGSY.

The third dimension of managerial quality in government related to the extent to which morality and ethics are considered to be desirable codes of behaviour among civil servants. This dimension is related to the vision of rural development held by senior-level policy-makers two decades ago and the influence it had on the work ethics of officers at district level. At this time, with the newly established DRDAs, came a sense of pride amongst rural development officers who were based in these agencies. As time went on, we began to see the frustration of district staff when they had to cope with implementing programmes like CRISP, which were designed and developed without their consultation. Morality and ethics of workers were important principles in guiding the behaviour of district-level officers towards boycotting the top-down system as imposed by the central government and the eventual development of locally relevant software which they tailored according to their own local requirement. With the recent diversion away from departmental information technology applications, which aim to improve the efficiency and effectiveness of development programmes, towards e-government applications, the need to improve work ethics within the bureaucracy became clear some years ago. In the last three years, the government of Gujarat has created an IT Division at the state level to closely monitor back-end information technology applications in government departments identifying a Chief Information Officer in each government department. In parallel with this trend, an initiative termed 'R-Government' which stands for Resurgence Government has been launched specifically designed to improve work ethics within the administration and to redefine the roles and responsibilities of government officers. This programme has currently been stalled.

The final component of managerial quality in government we have considered relates to the need for innovation and creativity of personnel. During the mid-1990s, the computer system at the DRDAs had prompted some degree of curiosity and self-learning and many DRDAs were beginning to think creatively about both the content of applications and about creatively managing their IT resource. State level support towards end-user applications triggered innovative uses of local technical support and data entry staff. Many districts began to identify useful categories of information for planning and monitoring purposes. For example, one innovative application related to the superimposition of three databases in order to arrive at a suitable scheme for a rural poor family – a household database recording details of income and assets, a scheme database recording details of linkages required for the scheme to be successful, and an environmental database recording details of local resources and infrastructure. Over the years, there has been a dampening of innovation and creativity among government personnel vis-à-vis DRDA computerisation. State level monitoring of both the IRDP and the SGSY in terms of targets and achievements continues to be carried out by the CRISP Cell, which merely consolidates the raw data sent from various districts. But whereas in the 1990s, DRDAs creatively generated their own monitoring criteria based on qualitative indicators relevant to the functioning of the scheme in their particular locality, no such innovation and creativity is noticed today.

IMPLICATIONS

Important policy implications follow from the findings of this study in terms of enhancing managerial quality in government through ongoing training and orientation sessions. These should necessarily be organised by state

[8] Yojana means scheme

level institutes and greater attention should be paid to general awareness building amongst DRDA officers of both computerisation and the SGSY scheme. Training by demonstration of more progressive districts could be used as an effective strategy to motivate other DRDAs towards more effective use of their computer resource. The identification of criteria for evaluating the SGSY should be looked upon as a continuous exercise and the state training institute should have an important role to play in enabling regular debate and discussion between the rural development department, non-governmental organisations, and leading experts on community development and micro-finance.

Policy implications also exist for the government's present focus on e-government. The government should adopt a two-pronged strategy paying attention not only to the introduction of applications which have a visible front-end such as rural telecentre projects or the development of web portals, but also to improving the back-end functioning and processes within government departments. This is essential for the efficient and effective execution of large development programmes such as the SGSY. Eventually, the government should realise that ultimately front-end e-services applications such as Mahiti Shakti, which aim to provide greater services than the printing out of government forms, will depend upon substantial reform of work processes and information flows within government departments.

At the same time, a wider policy implication of our study is that human resource enhancement is only one element which influences the sustainability of government IT projects. Also important is the need to foster closer links with the actors involved in the execution of a programme like the SGSY including existing government agencies like the DRDA and sub-district bodies, political bodies (panchayats), non-government organisations, banks and micro-finance institutions.

CONCLUSION

Much has been achieved in India over the last decade in terms of economic and industrial advancement and promoting e-governance interventions. At the same time, India remains a land of villages with more than 75% of its population living in rural areas. Considering this, no development of the nation can be successful unless it focuses on rural development planning and administration. A lot had been achieved in terms of administrative reform through DRDA computerisation during the 1990s and this experience needs to be carefully studied in order to understand its critical components. In this paper, we have drawn on our long experience of studying district-level computerisation in Gujarat and highlighted elements of managerial quality, which we found to be important in explaining previous usage of computerisation for rural development monitoring. Contrasting earlier experience with the current scenario, we conclude that if computerisation is going to have any beneficial impact on poverty alleviation, there is a serious need to focus on enhancing managerial quality in government.

Table 1

	Usage	*Local applications*	*Local IT management*	*Enthusiasm*
Surat	L	L	L	L
Ahmedabad	L	L	L	L
Dangs	L	M	L	H
Banaskantha	M	H	M	M
Baroda	M	M	M	M
Bharuch	M	M	M	M
Gandhinagar	M	H	H	M
Mehsana	M	H	H	H
Valsad	H	M	H	M
Kheda	H	H	H	H

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Understanding the interplay between actors involved in the development of an organisation for telecentre network management: The E-citizenship project of the City of São Paulo (Brazil)

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ABSTRACT:

The search for effective management of telecentre initiatives is one of the main concerns pointed out by ICT researchers, although it is still underresearched (Roman and Colle, 2001; Williams, 2001). This paper aims to fill the gap by studying the interplay between several actors involved in developing an organisation for telecentre network management network in São Paulo City - Brazil. The provision of equitable ICT-access in developing countries, through telecentres in poor urban areas, requires improving the management view in telecentres' movement. The paper uses Actor-Network Theory (ANT) to study the relationship among public and private agents in the implementation of telecentre network initiatives in the City of São Paulo. Our findings demonstrate the importance of individual agents' goals, the organisational learning and political dimensions in the process and its importance for user training, participation and citizenship development. The results provide useful insights for the management of digital inclusion programs in a Developing Country.

KEYWORDS: *Telecentres, ICT-access, Actor-Network Theory (ANT), Digital Divide, e-Government*

INTRODUCTION

Telecentres initiatives have become, over the past 10 years, an important Information and Communication Technologies (ICT) research subject in Developing Countries. In some cases the telecentres are seen as the solution to reducing the gap between those that "have" and "have not" ICT-access. Besides the concept of digital divide and its consequences, which are largely discussed by many authors and practitioners (Kuttan and Peters, 2003; Mossberger *et al*, 2003; Murelli, 2002; Norris, 2001; Servon, 2002; Williams, 2001), telecentre sustainability is another broad issue that concerns researchers. It is commonly accepted that sustainability is not limited to the financial support by donors (Harris *et al*, 2003; Kanungo, 2002; Proenza, 2001; Roman and Colle, 2001; 2002; Stoll, 2003; Stoll and Menou); equally important are the social, political, cultural and technical dimensions.

The search for effective management of these initiatives is one of the main concerns pointed out by ICT researchers, although deep analysis is still lacking (Roman and Colle, 2001; Williams, 2001). This paper aims at filling the gap by studying the interplay between several actors involved in developing an organisation for telecentre network management network in the City of São Paulo - Brazil. Extending equitable ICT-access through the installation of telecentres in poor urban areas requires an increased attention to management issues in the telecentres' movement. The paper uses Actor-Network Theory (ANT) to study the relationship between human and non-human actors in network telecentres initiatives in the City of São Paulo.

The next section introduces Actor-Network Theory as it was used as our theoretical lens. The third section presents the research problem and the main objectives of the study. The fourth section describes the process of how the study was conducted and also presents the setting of the study. The results of the study are presented in the fifth section: the case itself and its analysis based on the ANT perspective. Finally, we discuss our findings and draw some conclusions arising from the case study.

ACTOR-NETWORK THEORY

Actor-Network Theory (ANT) is a perspective developed by Callon (1986) and Latour (1987), to study science in action. ANT is an outcome of the interdisciplinary field of science and technology studies (STS) which emerged in the 1970s (Avgerou, 2002; Monteiro, 2000; Walsham, 2001). ANT is concerned with the creation and maintenance of coextensive networks of human and non-human elements which, in the case of information technology, include people, organisations, software, computer and communications hardware, and infrastructure standards (Walsham, 1997 p.466). The fundamental idea is that human and non-human actors[iv] interact to form the networks of heterogeneous entities of the world we live in. The process through which actors interact with each other to build or change networks is called "translation". Translation refers to both the process of "translating" an idea into reality and the result of such a process (Avgerou, 2002 p.61).

Callon (1991) describes translation as consisting of four steps: problematisation, *interessement*, enrolment and mobilisation. Madon *et al* (2003 p.22) defines Callon's steps as: problematisation relates to the process of becoming indispensable by presenting the solution to a problem in terms of the resources a person or group owns. *Interessement* follows successful problematisation where actors experiencing the problem are convinced that the only way to resolve their problem is by addressing the articulated solution. The actors then need to be isolated to limit external influences that could challenge the legitimacy of the solution. Enrolment is the third (translation) step during which alliances are consolidated through bargaining and concession making. Finally, through mobilisation of allies, actors become legitimate spokespersons of the groups they claim to represent. This leads to strengthening and stabilization of the network.

ANT has arisen as an alternative approach to social construction of technology (SCOT) (Bijker and Law, 1992). However, even with some disadvantages pointed out by Walsham (1997), and the dispute over its claim of being a theory (Law and Hassard, 1999; Monteiro, 2000), there has been an increase in ANT-based information systems studies particularly since the mid-1990s (Avgerou, 2002; Macome, 2002; 2003; Madon *et al*, 2003; Mcmaster *et al*, 1997; Mcmaster *et al*, 1999; Monteiro, 2000; Mosse and Sahay, 2003; Vidgen and Mcmaster, 1995; Walsham and Sahay, 1996)[v] The authors agree with Hanseth and Monteiro (1998) who argued that ANT could bring us "...one step further towards a more detailed understanding of the relationships between information technology and its use". This is possible because ANT is based on the link between technical and non-technical elements and also recognizes "... the material embodiment of 'scripts' in technology as significant unlike SCOT" (Avgerou, 2002 p.63).

RESEARCH PROBLEM AND OBJECTIVE

Telecentres are physical spaces that provide individuals, community groups and local organisations with public access to ICTs for educational, personal, social, and economic development (Gómez *et al*, 1999). Despite the general agreement on this definition, the telecentre concept is still an object of debate among researchers and practitioners in several discussion lists[vi]. Telecentres, as a promise of ICT-access for all, aiming to bridge the digital divide are facing several different problems. Firstly, the physical availability of ICT ("connectivity"), which is distinct from mere "access", refers to the economic, sociological and psychological factors that influence a person's opportunities to use the technologies (Roman and Colle, 2002). Secondly, the relevance of telecentres for their clientele is reduced by local people's illiteracy, lack of information culture and technophobia. Finally, unclear objectives of telecentres characterise one out of many obstacles that researchers and practitioners have to face in the study of telecentres' initiatives. This last issue is especially problematic in the development of telecentre initiatives, considering that a management approach is decisive for the sustainable development of telecentres with a long-term view. The purpose of the present paper is to provide a better understanding of the interplay between the actors involved in the development of an organisation for telecentre network management.

RESEARCH SETTING, DESIGN AND METHODS

The history of the telecentres' movement in Brazil includes NGOs initiatives and also E-Government projects. The present case study focuses on a governmental telecentres network developed in São Paulo, the world's 4th largest urban conglomerate, with 18,4 million people in 2002 (IBGE, 2003).

The telecentres' movement in Brazil is very recent and few academic studies are available (Assumpção, 2001; Macadar and Reinhard, 2002). The research approach chosen to analyse the case study is based on an interpretative perspective (Walsham, 1993), allied with ANT (Callon, 1986; 1992; Latour, 1987; 1992) to

understand the interplay between human and non-human actors involved in the telecentres network. This paper is part of a larger initiative of studying major Brazilian telecentre initiatives and uses data collected during a longitudinal study between 2001 and 2003. For the E-citizenship project the authors interviewed the co-ordinators and their advisers and also some of the main partners (including leaders of the local communities). The partners' selection to be interview was made based on suggestions provided by the program managers and from citations in the media during the period.

THE CASE STUDY

There is a variety of projects in Brazil related to digital inclusion. Some of them were initiated by NGOs (e.g. *Viva Favela* – www.vivafavela.com.br/english.asp and *Cibersolidário – Cipó Comunicação* – www.cipo.org.br), while others are supported by private companies (e.g. Hewlett-Packard's *Garagem Digital* - www.abrinq.org.br and Intel's IntelClubhouse). Some focus on specific subjects, such as: disability (*Rede Saci* - www.saci.org.br), gender (*Consulado da Mulher* – www.consuladodamulher.com.br), education (*Telemar Educação* – www.institutotelemar.org.br) and digital literacy (*CDI* – www.cdi.org.br). There are also large telecentres networks initiated and supported by governments. This paper focuses on the E-Citizenship Project (www.telecentros.sp.gov.br/) coordinated by the City of São Paulo Department of Social Communication and Information.

The E-Citizenship project

In the history of the E-Citizenship Project there are three distinct phases:

- the ***initiation phase:*** from January 2000 to December 2000;
- the ***implementation phase:*** from January 2001 to December 2002 and
- the ***phase of consolidation:*** from January 2003 to December 2003.

Figure 6 presents the main events in each phase that are described in the following sections.

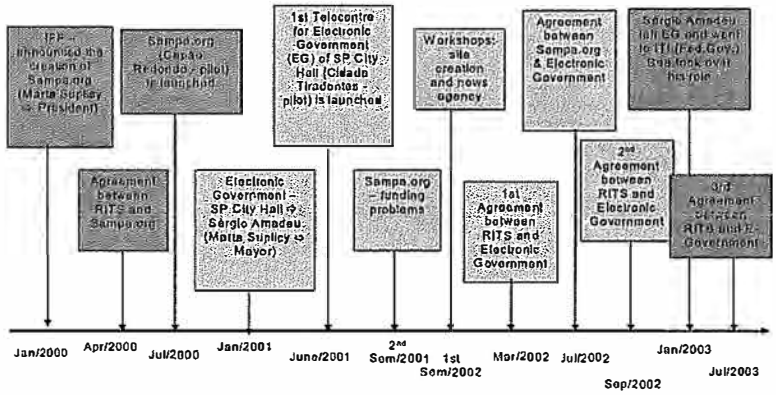

Figure 6 – Main events of the Project.

The initiation phase

In January 2001 Marta Suplicy, from the Workers' Party[vii], became the Mayor of the City of São Paulo, and created the E-government Co-ordination Office (CGE). One of the major projects of this office was the creation of the E-Citizenship Project, This project was an extension of an existing pilot program - Sampa.org - instituted one year earlier in São Paulo by the Florestan Fernandes Institute, (IFF), a research and social development NGO supported by the same Workers' Party. At that time Marta Suplicy was the President of this Institute and Sérgio Amadeu the Sampa.org project director. The Sampa.org workgroup, created by IFF in January 2000 was able to secure resources from private enterprises, civil social organizations and secondary schools to implement the Sampa.org project. In April 2000, before launching the pilot telecentre, Sampa.org signed a formal agreement with RITS[viii] for the development of common initiatives related to the installation, development and maintenance of community IT access centres, focusing on evaluation, training and dissemination of experiences. In mid-2000 the Sampa.org opened its first telecentre in Capão Redondo, a very poor and violent area in São Paulo, with one of the worst HDI (Human Development Index) in the city. The close political relationship between local leaders and Sampa.org's workgroup was considered a strong reason to start the project in that area.

The implementation phase

The CGE was created with two main objectives: to develop the São Paulo City Government Internet Portal and to offer ICT-access to the poorer segments of the population, in order to allow them to take advantage of e-government services and, at the same time, increase their social inclusion. Unifying the different sites of São Paulo Local Government on a single website (there were around 13 different sites) and instituting one single Portal was not too difficult. A greater challenge was to promote the inclusion of the large part of the population without access to ICT. Besides using the e-government services, the project aimed at developing citizens' capabilities for e-democracy and participation.

Sérgio Amadeu, the former IFF Sampa.org project director, took over the role of CGE's project manager and in June 2001 its first telecentre was opened in a public building located in Cidade Tiradentes, another poor area of the city. The location was also chosen because of its very low HDI (Human Development Index). However, other aspects, such as an adequate space and technical conditions to host a telecentre were also considered, besides the interest demonstrated by local community leaders in having the telecentre at all.

In the beginning the telecentres were housed in public buildings or abandoned or unused commercial premises. During that year the project arranged for 20 public buildings to be repaired, but soon there were no more public buildings available in poor regions where telecentres could be installed. Then the project managers decided to look for buildings of civil society entities in locations needing a telecentre, providing financial resources for refurbishment aiming at creating adequate space to set up the telecentres. The entities that received a telecentre would be legally responsible for all the equipment and furniture supplied by the City Government. In December 2003 there were around 80 of these partner entity telecentres, besides the first 20 telecentres managed directly by the Project.

In the second semester of 2001, the original sponsors left the project, leaving the 10 telecentres operated by Sampa.org with severe funding problems. In mid-2002 Sampa.org firmed an agreement with the City Government, allowing CGE to incorporate their telecentres into the E-Citizenship project, therefore assuring the survival of Sampa.org's telecentres.

Sampa.org had accumulated a valuable experience in community projects that was used to help enhancing the SP City telecentres. The "Capão Online News Agency"[ix] and the "Jardim Angela Information Center"[x] are some of these initiatives that inspired small local community groups to develop their own projects.
In addition, during the first semester of 2002, some local telecentres coordinators perceived the need for community journalism, leading to workshops conducted by volunteer professionals.

The consolidation phase

In January 2003 Luis Inácio Lula da Silva, from the Workers' Party, became the Country's new President. The ensuing substitutions of executives affected also the E-Citizenship project: Sérgio Amadeu, its general manager went to become president of the Federal Government's National Institute of Information Technology. Beatriz Tibiriçá replaced him changing the project's focus from "quantitative" to "qualitative" that is, changing from the goal of installing growing numbers of telecentres, to increasing the usefulness of the existing telecentres to their users.

Another fact that characterizes this consolidation phase is related to a series of agreements between RITS and CGE. RITS had worked for Sampa.org. This collaboration was extended to E-citizenship Project by CGE, first in March 2002 and again in September 2002. However, only in July 2003 a definitive and wider agreement was sealed between these institutions, demonstrating the importance of technical and operational support in a public project from organisations with experience in dealing with users and telecentres' staff. These agreements helped the telecentre in their day-to-day operations, especially when the amount of telecentres increased abruptly in a short period of time. Since March 2002 the RITS has become responsible for the selection and hiring of telecentres' monitors, trainees and technical agents. RITS is also responsible for:

- Training city government employees working in the telecentres;
- Supporting project coordination with statistical reporting activities;

- Supporting Local Management Councils (each telecentre has its own Council, whose members are elected by the community);
- Supporting telecentres community activities; and
- Collaborating with the Telecentres Free Software development.

Engaging RITS also freed the City from the legally difficult task of hiring and managing directly the telecentres' staff.

Other E-citizenship project partners

The E-citizenship Project has many different partners from government, private companies and civil society organisations, such as the RITS mentioned above (and indirectly the hispanic Somos@telecentros – www.telecentros.org), and local NGOs, which have been developing an important part in this project. Besides the local institutions (e.g. churches, neighbourhood associations and social movements) we could observe that the *Technical Agents*, the local telecentre managers, also have an important role in the project. They are seen as allies of the CGE rather than just employees. The growth of the program made it increasingly difficult to manage all telecentres from a central office, requiring the creation of the position of *Regional Technical Agents*, each one responsible for coordinating 6 to 10 telecentres. Additionally, there are many volunteers, most of them young people from the community and also some from NGOs who helped the project by organizing a textbook for basic informatics courses, that is used in all telecentres.

Private companies contribute mostly by donating computers and furniture, telecom and internet services, computer maintenance and repairing buildings.
Figure 7 illustrates this network's actors.

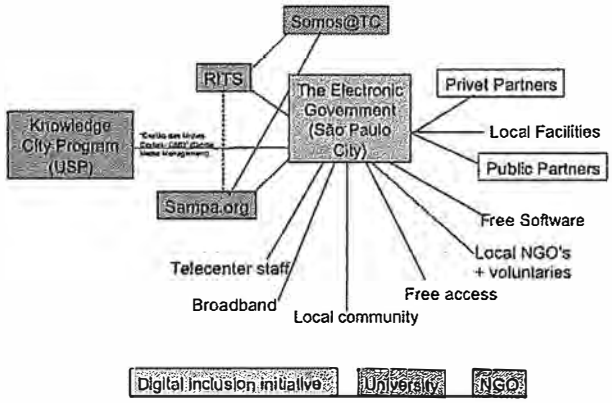

Figure 7 - E-citizenship project actors.

Analysing the E-citizenship project through the ANT lens

The main objective of this section is to analyse the case study drawing on the four moments of translation (Callon, 1986): problematisation, *interessement*, enrolment and mobilisation.

Problematisation

Problematisation is the first moment of translation during which the initiator, in the present case study the CGE of São Paulo City Local Government, defines identities and interests for other actors that are consistent with its own interests, and establishes itself as an "obligatory passage point", thus "rendering itself indispensable"(Callon, 1986 p.196). The telecentre initiative was *problematised* as the need to provide ICT-access to those that "have not". The CGE knew beforehand that creating a pleasant and useful e-government portal would not be enough, especially since the majority of the population could not access it. Therefore establishing telecentres that could provide free ICT-access in poor regions appeared to be a solution to the problem. Another important issue problematised by the initiator was the concept of the telecentre itself. Providing not only free access, but also tools for participation in the democratic process, was used as an argument to convince other actors about the importance of the project.

This solution, however, demanded many different resources: human resources able to support the project and, equally important, experts with experience in telecentres, financial resources, especially in the beginning of the project when the installation costs are higher. In view of this scenario, the City's CGE was seen as the solution. The Administration had some expertise (through their participation in the previous Sampa.org Project), human resources and, foremost, the budget to implement the project. Later, the City Government became also the solution for Sampa.org's financial woes, when its former supporters withdrew, while local communities kept requesting more and more telecentres.

The focal actor defined that telecentres with free of charge access and using free software would be essential. The CGE became the indispensable gateway, through which the other actors had to pass, since it had all the resources needed to build and maintain a project with those characteristics.

"Interessement"

Interessement is the second moment of translation which concerns the process of convincing other actors to accept the focal actor's definitions (Callon, 1986). The beginning of the E-citizenship Project was marked by negotiations between CGE and its potential additional sponsors (private companies at first), to help create the telecentres infrastructure. Sampa.org's experience showed the main road to follow. However, lack of financial resources in the beginning of the project created difficulties and delayed the Project[xi]. To overcome this situation, intensive and hard negotiations between all actors involved were necessary. By showing several possibilities and benefits of installing a telecentre in a local community the initiators raised the interest of new actors in using the telecentre facilities, specially the users. The pilot telecentre in Cidade Tiradentes was able to prove that a telecentre could be very useful for local and poor communities, enhancing its surroundings. The Sampa.org experience helped to convince this local community and became a model to be followed and a demonstration that it is possible to achieve good results with this initiative. Furthermore, a local NGO ("Consciência Ecológica") participating in the pilot was approached by the initiators early in the process. Its local power influence was indispensable and helped in explaining to community members several possible project implications. This actor, without a doubt, helped to ensure the success of the project. Its influence was very important to increase user commitment and engagement, especially during the initiation phase. Particularly at that moment, the local contacts were highly important since they could use their own language (way to think and express their ideas).

These members knew the community's history and the politicians' promises. This means that even before the installation of the telecentre infrastructure, different actors were already ***locked in*** the telecentre's idea. Recognizing that the focal actor has the solution, other actors must follow his "rules". Even though the initiator tried to show a "democratic" way to deal with his partners (e.g. Local Management Council - MC), he dictated the rules and demonstrated the roles for each actor to play. The "working plan", a kind of readiness guide, was another way to lock in those institutions that had an agreement with the City Council. The CGE document detailed procedures for installation, operation and clearly stated the telecentres objectives. The staff selection process was based on political recommendations and technical criteria. Members of the local community could indicate whom they considered to be reliable. These aspects were very important to ensure the success of the telecentre initiative, since they were committed to their community. For all these reasons, we can consider the selected staff as ***spokespersons*** for the initiative.

Enrolment

The enrolment can be seen as the moment in which another actor accepts the interests defined by the focal actor. The process to enrol users was not as difficult as dealing with the group of partners supporting the project, which demanded detailed negotiations. Every sponsor's interest was negotiated in details - by informal or even formal ways - before an agreement could be reached. The change in MC's members' profiles is a good example of enrolment. Most of them, prior to the telecentre's installation, were people engaged in local community projects, and naturally became part of the MC. However, the majority of the MC members are not everyday in the telecentre. They are very good local community members, who know a lot about the local needs and their history, but they are distant from the particular telecentres' needs that only daily users know. Nowadays it is possible to observe that, little by little, the members' profile is changing. This change can be seen as an enrolment, since the actors (MC members) accept the interests defined by the CGE, and engage actively in the telecentres activities.

Moreover, two enrolment strategies can be seen to be built upon two distinctive features. The first is a couple of publications: "All this people" and "Free Software and Digital Inclusion". Both publications were edited by

Sérgio Amadeu, while he was CGE's director. The second strategy is related to the action of making concessions so that other actors would accept the initiator's interests. Initially, one thousand telecentres were claimed to be necessary to cover part of the digital gap in the City of São Paulo. After some time, the CGE stopped to emphasize this number. This fact suggests that, since then, a concession was made. The initial objectives were "changed" and to make it possible to maintain the focal actor's position, the choice was to change the discourse from a "quantitative" to a "qualitative" project. In other words, it was defined to be better to improve the current telecentres than to install new ones.

In fact, CGE soon recognized that the initial goal (of installing 1,000 telecentres) was unattainable in view of the project's resources (human and financial). As the focal actor who has to maintain its legitimacy towards the other agents, CGE made a "concession" substituting (and emphasizing) qualitative goals, such as content generation (in local and project home pages), user training and education, quality of user involvement, etc. for the previous quantitative goal.
However, the enrolment strategy did not always work. For the development of special users' skills, specific workshops (e.g. site creation, news agency operation) were offered made-to-measure to telecentre community. These workshops happened in several telecentres, but were effective in only a few of them. In this case, we can affirm that the ***interessement didn't achieve enrolment***, so it was not successful (Callon, 1986 p.211)

Mobilisation

"Who speaks in the name of whom?" (Callon, 1986 p.214). The CGE, as initiator of the project, defined the telecentres as an obligatory point of passage (OPP) and engaged itself in the process of persuading community members to see the initiative as their own project. This point is especially important when we analyse the project as a public policy. The initiator group will not continue forever in the city council government. Likewise, nobody knows whether the next administration will continue the telecentres' project. With this in mind, the initiator created mechanisms to make the local community feel as owner of the telecentre. For instance, we can mention the MC creation. When the first telecentre was launched, the CGE followed up on each day-to-day action. After a while, the MC was created and became the community spokesperson. This aspect can be seen as a public policy for assuring the sustainability of projects like E-citizenship.

The location in which telecentres were installed is another aspect of "mobilisation". One selection criterion was the level of community activity and the possibilities to link these activities with the telecentre operation. Well organized local communities were more easily involved than those which had weak community links. Besides, there were some that felt suspicious about the initiative, especially because they did not understand the purpose of the project. However, nowadays, many local communities are asking for their telecentre. Some of them, after seeing the first telecentres in operation and their advantages, started to prepare their sites to improve the chances of being selected to host a telecentre.

An important contribution was a course offered by a social development program of the University of São Paulo (GMD - "Programa Cidade do Conhecimento" - Knowledge City Program). From August 2002 to March 2003 this program entertained a discussion group composed of different actors related to digital inclusion projects. The result was the development of multiple alliances with other actors in São Paulo and the creation of a highly visible knowledge network, although concrete results have not been observed yet, besides building stronger public support for the project.

Although all the above-mentioned mobilisation initiatives are significant, it is premature to argue that the E-citizenship Project is fully mobilized. Furthermore, it is still not possible to confirm that all actors are now speaking on behalf of the project, since a few resistance signs can be observed in local communities leaders. For instance, they sometimes demonstrate fear of losing their local power or private actors that have their own interests may go away anytime.
In order to illustrate how the ANT attributes described above are mapped in the telecentre project we developed the Table 7.

	Problematised point: telecentre providing free ICT-access and participatory tools to management the initiative. CGE with financial and human resources to implement a telecentre with those characteristics.
	Interessement: previous experiences helped to convince other actors to approve the CGE definitions. Some actors were locked in before the installation of the telecentre. Local community indicate local staff and they became spokespersons for the initiative.
	Enrolment: actor accepts the interests defined by the CGE. Transformation of the local management council profile since the beginning of the project. Enrolment strategies: publications and making concessions for other actors to accept the initiator's interests.
	Mobilisation: the role of the local management council in community organised beforehand. The role the neutral actor as GMD was in this case. The idea behalf of free software use in telecentre.

Table 7 - ANT attributes and the E-citizenship Project

DISCUSSION AND CONCLUSIONS

The E-citizenship Project suggests several insights for researchers and practitioners interested in studying and improving digital inclusion projects. The three different phases described in the case study (section 0) illustrate aspects that were subsequently analysed by using ANT. Each actor, human and non-human, involved in the project had a distinguishable role in this scenario. Although not all actors were shown and detailed, it was possible to perceive how the major players were involved during the three different phases of the case. Besides the implications for digital inclusion projects, the analysis of this case could also help by informing E-Government projects and public policies related to digital inclusion. It demonstrated the importance of the support given by NGOs as RITS and Sampa.org which provided the know-how required to reach the objectives of the project. These actors', however, acted top-down, since they were not part of the local community when the project was started. In contrast, the MC could be seen as a participatory tool since it is supposed to represent the different segments of the local community. However, it was possible to observe that this assertion was not always true. In some cases, especially in the beginning, the pre-existent leaders entered the MC and inhibited - directly or indirectly - the participation of others that usually are not involved in such activities. Nevertheless, this situation changed over time. During the renovation of the MC members in the first telecentres it could be observed that more users and operators entered the process. The local community seems to recognise the importance that MC members be acquainted with daily problems and opportunities.

There is a large discussion about the creation of participatory mechanisms in poor areas, especially in those communities where democratic tools are not, or were never used before. For this reason we can state that, even with all its problems, the MC was a good way to deal with a challenging situation. On the one hand, the CGE dealt with local communities with little experience in shareable processes and where few leaders use to arise. On the other hand, even with this scenario, the CGE had to start somewhere. Therefore, they began by operating with those that had some experience in dealing with their community. This case showed that a double choice is possible: a kind of top-down project at the beginning and a bottom-up after a while.

From our point of view, there is a continuum between those telecentres which have less community participation and those which have more community participation. This continuum not only could explain the community participation level, but also the local activities level linked with ICT-access. It could also be observed that most telecentres having high participation and level of activity are those that were installed in the beginning of the project or came from the Sampa.org project. At the same time, we can say that these telecentres have a kind of "local vocation" that makes them useful to their community. For instance, if they have activities focused on women problems, they would be using the ICT to enhance these activities. However, the local leaders' view is very important in allowing this to happen. In addition, it is indispensable to have a clear view of how the ICT-access can improve the local community's quality of life.

The project helped raising users awareness of the importance of information as a valuable resource and identifying the telecentres as a vehicle for professional training and building citizenship. To reach this level of ICT the telecentres had to become relevant to their users. This means that the content offered by the telecentres

had to be perceived as being significant for the local community. This required significant variation among the telecentres, in order to fit local communities' vocations and interests. This "made to order" demand is not an easy goal to attain, especially in view of the large program size and the centralized management structure of the Government. Generating locally relevant content is a continuous challenge both for the involved communities, partnering organisations and the Program Management.

In order to fit the community needs multiple alliances were necessary. These alliances, however, were not created to supply content as could be thought of at the first moment. Their main purpose was related to the telecentres' sustainability, by supplying human and financial resources and also providing know-how to deal with local situations. The specific workshops had also this concern, but instead of producing the content, the objective was to develop users' and operators' skills so as to turn them into information providers. This is hard work that has just begun and, undoubtedly, there is a long way before it will achieve visible results. The exchange of information between the involved agents is an important factor, not only referring to the assistance from those who have the know-how and know-what, but also how other actors (human and non-human) should be regarded. At the same time, it also demonstrated to value of aggregative actors such as the University's consultants. Although the GMD purposes have not been attained in a visible way, the exchange of experiences between the participants promoted by this program has already begun. Moreover, they realised that together their chances obtaining external support could increase significantly.

From the three phases of the case study described in section 0 we could observe the important role of each actor in each period of time. During the first phase, the "initiation phase" the Sampa.org pilot telecentre and the agreement between RITS and Sampa.org provided a very good experience for the second phase when the initiator had to prove its capacity to develop a project like E-citizenship. Despite all the political, economic, cultural and social obstacles, the CGE could arrive at the third phase (the "consolidation phase"). Even changing its discourse, from "quantitative" to "qualitative", it was possible to consolidate a net of telecentres with more than 100 contact points and local community asking for new locations. In summary, there is a general agreement that CGE reached its purpose, with users (although not too many) confirming that the telecentres helped them in their day-to-day activities and in the improvement of their quality of life. Education initiatives, with the use of ICT in local community activities could help in reaching this goal. There is still a long way to go to extend these benefits to all other users and to generalize their participation and citizen development.

The experience with the mobilisation of local NGOs and community could also help in reaching this goal. However, as this case study intended to demonstrate, it is extremely important to focus on the interplay between social and technical actors to achieve positive results. The program helped in society's recognition that providing equitable ICT-access is an important way of improving human resources capabilities, enhancing democratization and citizenship.

After the writing of this case, the recent elections caused a significant change in the City administration. There is also an increasing social criticism of the free telecentre approach because of its apparent inability to demonstrate a convincing cost-effectiveness, and the difficulty of escalating the model to serve all users needs. This may start another process of problematisation with a new set of actors.

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EXPERT ASSESSMENTS OF CULTURAL EFFECTS ON E-BUSINESS IN DEVELOPING COUNTRIES

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ABSTRACT

This study investigates experts' assessments of the pertinent factors on certain cultural factors on affecting e-business in developing countries. We design and conduct a survey that empirically solicits information from experts in e-business in Sub-Saharan Africa (SSA) in the first phase (completed and reported here), and in Latin America in the second phase (currently in progress). Our initial results for SSA using PLS analysis show that experts believe that ICT transfer implementation strongly affects both e-business capabilities and value, but that among SSA countries, there are no significant cultural effects of power distance, uncertainty avoidance, or technology culturation. Furthermore, they do not believe that there is any significant interaction between culture and transfer implementation within SSA. This study theoretically and empirically distinguishes between two different dimensions of e-business outcomes: specific capabilities and value derived from e-business. As part of the first study that conducts a quantitative, broad-based survey on factors that contribute toward e-business in the Sub-Saharan Africa and Latin America regions, it gives cause to question the common argument that native culture significantly affects the adoption of ICTs.

INTRODUCTION

E-commerce is one of the most visible examples of the way in which information and communication technologies (ICT) can contribute to economic growth. It helps countries improve trade efficiency and facilitates the integration of developing countries into the global economy. It allows businesses and entrepreneurs to become more competitive. And it provides jobs, thereby creating wealth.

Kofi A. Annan, Secretary General of the United Nations

This statement by the Secretary General (UNCTAD 2002) points to the paramount importance of electronic business (e-business or e-commerce) diffusion as a major impetus for socioeconomic development in developing countries. E-business—business transactions or processes using the Internet—has the potential to be self-propagating and self-sustaining, the holy grail of development researchers and organizations on their quest for sustainable development. By fostering internal and external trade, e-business might create and attract wealth that could be used to develop structural infrastructure such as roads, telecommunication networks, and dams; and social infrastructure such as hospitals and schools. Hence, focusing on the commercial applications of the Internet in developing countries is a valuable perspective, since such applications potentially would have significant beneficial effects on all other applications of the Internet, such as telemedicine, online education, and electronic government.

There has been a wealth of information systems research that has studied information and communication technologies (ICTs) in developing countries (El Sherif and El Sawy 1988; Jarvenpaa and Leidner 1998). Among many proposed factors, there have been numerous arguments that various cultural beliefs and attitudes play an important role in the successful adoption or transfer of ICTs in developing countries. There has been a considerable amount of research arguing that the beliefs and values that people have ingrained in them by their cultural context significantly affect their thinking and perspectives, and hence their approach to using technology

(Straub 1994; Straub 2001). Such arguments have been made concerning Latin America (Travica 2002), the Middle East (Hasan and Ditsa 1999; Straub 2001), and Sub-Saharan Africa (Hasan and Ditsa 1999). A particularly notable stream of research has been an extended study of the effects of policy and culture on information technology (IT) in Arab nations (Straub 2001). Hill et al (1998) and related studies found that various Arab cultural characteristics had significant effects on their acceptance of various ICTs. A few studies, on the contrary, have argued that culture per se is not responsible, but other factors such as the political environment overshadow its effects (Korpela 1996; Powell 2001).

A number of studies have theoretically examined the effects of culture on ICT development in general; however, very few studies have specifically examined the effects of culture on e-business in developing countries. Based on the importance of e-business on developing national infrastructure and the quality of life in the world's poorer countries, we are conducting this present study as part of a larger research program that investigates the pertinent general factors affecting e-business in developing countries. While the focus of the research is primarily on e-business in the Sub-Saharan region, this particular study, based on the theoretical importance of culture in ICT adoption and transfer, focuses on answering the question:
What cultural factors contribute toward effective e-business outcomes in developing countries?

Theoretical background for E-business in Developing Countries

Information systems research has produced many frameworks that examine different dimensions of factors necessary for supporting e-business (for a comprehensive review, see Ngai and Wat 2002). This research covers e-business applications, technological issues, support and implementation, and many other aspects. In the midst of this breadth of research, the Arab Culture and IT (ACIT) project (Straub 2001) has been particularly important, spawning a large stream of research that investigates various aspects of ICT outcomes in developing countries in general, and in Arab nations in particular (Straub 2001).

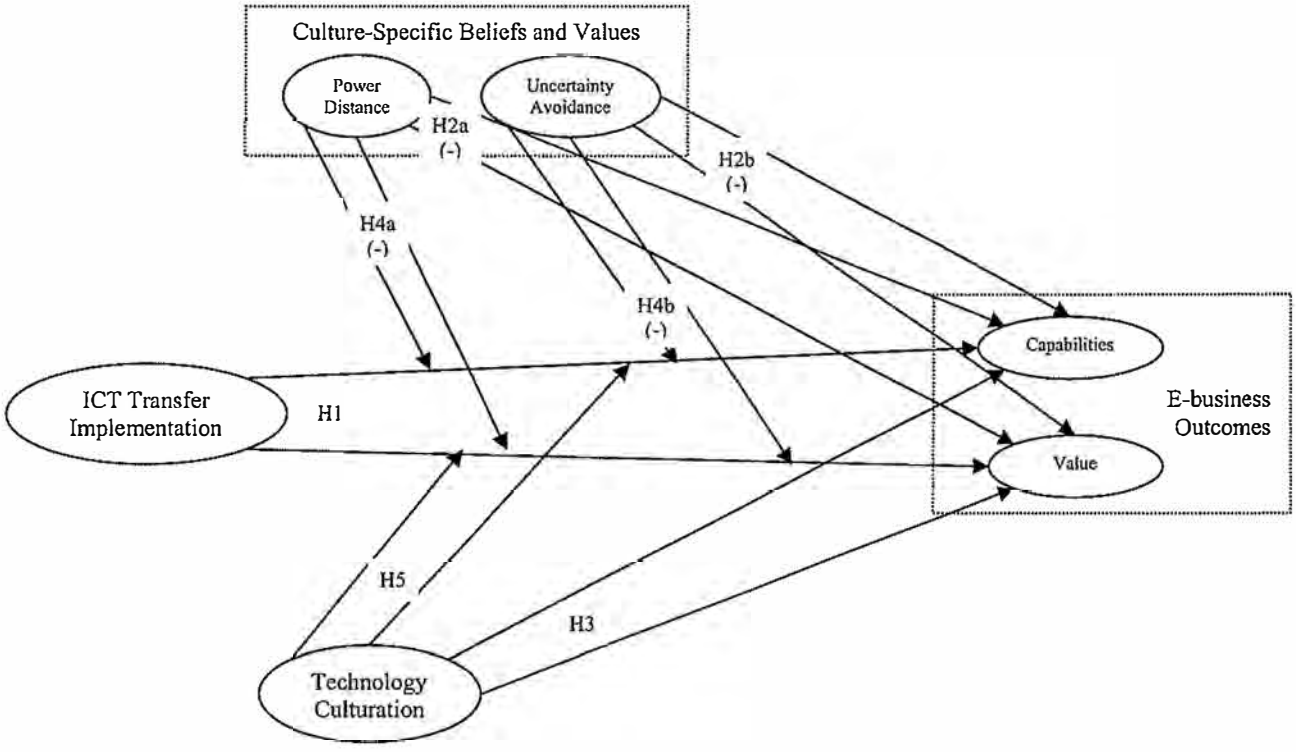

Figure 1. Cultural model of e-business outcomes

Based largely on ACIT, as well as research streams of e-business frameworks, ICT diffusion, and ICTs in developing countries, we have developed a general model, illustrated in Figure 1, that explains what pertinent factors affect e-business in developing countries. In this model, the primary endogenous (dependent or predicted)

construct is **E-business Outcomes**, indicating the practice of e-business. This construct has two dimensions: **E-Business Capabilities**, the specific business functions that e-business is used for, and **E-Business Value**, consisting of measures of the benefits of using e-business.

The model has three predictor constructs that we postulate directly affect e-business outcomes: ICT Transfer Implementation, Culture-Specific Beliefs and Values, and Technology Culturation. **ICT Transfer Implementation** affects the effectiveness of the process of adopting ICTs in general, and e-business tools and practices in particular. At this level there are two specific culture factors: First, **Culture-Specific Beliefs and Values** specifically includes the effects of **Power Distance** and **Uncertainty Avoidance** on E-business Outcomes. **Technology Culturation** is the influence of technologically-advanced cultures on an individual's attitude to technology. In addition to their direct effects on e-business, we propose that the cultural factors also moderate the effect of ICT Transfer Implementation.

All the factors in the model (see Figure 1) assert a positive influence on the construct they affect, except for Culture-Specific Beliefs and Values. In general, some such factors could be positive, while others might be negative, as we describe below. However, in our research model where we use Power Distance and Uncertainty Avoidance, we propose that both of these effects (and corresponding interactions) are negative.

E-Business Outcomes: Capabilities and Value

From the literature review, we observed that there are two general aspects to evaluating e-business, particularly from an empirical perspective. First, many studies examine the actual applications and functionality that e-business enables; that is, they emphasize the **Capabilities** that e-business enables, such as providing product information, interactive websites, online transactions, etc (Kardaras and Karakostas 2001; Zhu and Kraemer 2002). One of the challenges in harnessing the potential of e-business has involved understanding how best to measure it in order to maximize its benefits. A second aspect of evaluating e-business involves assessing if it delivers its promised benefits; that is, if it provides **Value** to the businesses that employ it. Value, or the success of e-business, can be measured from many different perspectives. It can be evaluated in terms of increases in sales, profits, or customers. It can be seen from the perspectives of saving costs, increasing process efficiency, saving time, reducing personnel requirements, and so on.

ICT Transfer Implementation

Our primary interest in the cultural model is to examine how culture affects e-business outcomes in developing countries. However, "culture" does not operate in a vacuum; rather, it operates in the context of trying to implement, maintain, and support systems. Thus, we include ICT Transfer Implementation in our model, as did Loch et al (2000), to provide a base for studying cultural effects.

ICT implementation is one of the oldest streams in information systems research. Over the years, various studies have provided evidence that both the presence of critical success factors in the implementation process and the process of project implementation are important to assure the success of an ICT project. Loch et al (2000) lists the following commonly identified factors: top management support, individual differences, system quality, firm characteristics, and user-developer interactions.

A number of studies have investigated if these factors identified in developed countries also apply to developing countries (Bingi, Leff, Shipchandler and Rao 2000). In general, most of the factors are equally applicable in both contexts. However, Bingi et al (2000) identified several issues that developing countries have to face that are not quite as important or common in developed countries: human resources, technical concerns, and socio-political challenges. Regarding human resources, ICT workers in developing countries are limited in their opportunities for career advancement. Regarding technical issues, there are concerns about the quality, security, and availability of data. Socio-politically, there are challenges that arise from illiteracy, the language barrier, and vulnerability to foreign control.

Based on the importance of these widely recognized factors, we offer the following hypothesis in our model:
Hypothesis 1: Effective implementation of ICT transfer projects will (I) increase the capabilities of e-business and (ii) yield valuable e-business outcomes.

Culture

A few studies have examined the cultural effects on technology in Sub-Saharan Africa (Hasan and Ditsa 1999; Korpela 1996). Studying the root causes of organizational obstacles to IT diffusion among the Yoruba ethnic group in Nigeria, Korpela (1996) concluded that culture per se had little influence on the effectiveness of ICT in that society. Rather, he argued that a historical political economy that hindered true democracy played far more of a role. In contrast, Hasan and Ditsa (1999), comparing Australian, West African, and Middle Eastern information systems development environments, found that cultural predisposition did play a part in differential results. There are numerous cultural effects that we could test, but for a study of this scope, we can only focus on a few of the most pertinent ones. In the following sections, we examine the specific cultural effects that we will test, explaining why these are particularly relevant in a study of this nature.

Culture-Specific Beliefs and Values

There is an inherent problem in trying to conceptualize Culture as a monolithic construct. Hofstede (1980) empirically conceptualized culture into distinct sub-constructs, with his four-dimensional scheme of Power Distance, Uncertainty Avoidance, Individualism-Collectivism, and Masculinity-Femininity.

While these dimensions all influence the work context, their effects are not equal. Shore and Venkatachalam (1996 p. 22) observe that only two of these are most pertinent when considering the organizational level of analysis, reflecting "the way decision-making power in organizations is distributed, rules and methods followed, and uncertainty accepted": **Power Distance** is the social distance between authorities and subordinates, indicating how much respect superiors expect and subordinates give; **Uncertainty Avoidance** is the aversion to risk, and indicates how much people prefer stability over risky possible benefits.

A somewhat different approach, with a particular view to how culture influences the use of technology, comes from Straub et al (Straub 2001) in the ACIT project, who divided the Culture construct into two dimensions. First, there is **Culture-Specific Beliefs and Values**, which represents specific beliefs or values that a person might hold because of the influence of their cultural background. The emphasis here is not the cultural background—a multidimensional concept, but the beliefs and values that follow as a result.

In this study we merge the two perspectives by focusing on Hofstede's culture dimensions of Power Distance and Uncertainty Avoidance within the context of Straub et al's (2002b) first dimension of culture, Culture-Specific Beliefs and Values. Hasan and Ditsa (1999) found that high power distance (as in West Africa and the Middle East) impeded business managers from taking sound advice on technology issues that more qualified subordinates might have. They also found that, since ICT projects can be quite risky, low uncertainty avoidance (as in Australia and West Africa) enabled managers to take on more ICT projects—though this did not guarantee the success of the projects.

Based on these findings, we make the following specific hypotheses regarding Culture-Specific Beliefs and Values:

Hypothesis 2a: Less power distance between managers and subordinates will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

Hypothesis 2b: Less avoidance of uncertainty in business decisions will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

Technology Culturation

The second dimension of Culture that Straub et al (Straub 2001) conceptualize is **Technology Culturation**, which represents a person's exposure to a relatively high technology-intense culture. This construct assumes the perspective of a culture lacking certain technologies that receives these technologies from an outside culture. In the context of studies of ICT diffusion in developing countries, this could indicate the degree to which a citizen of a developing country has been exposed to more technologically advanced cultures such as Europe or Japan, whether by traveling to these countries or by exposure to media such as computer magazines and television. In their studies of ICT diffusion in Arab nations, Straub et al (Straub 2001) found that Technology Culturation did indeed provide a consistently positive influence on ICT outcomes, particularly when conceptualized as traveling to such countries.

In light of their findings, we make the following specific hypotheses regarding the effect of Technology Culturation on e-business outcomes:

Hypothesis 3: Greater exposure to business ICTs from advanced nations will (I) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in Developing Countries.

Interaction between Culture and Transfer Implementation

In their studies, Straub et al also proposed that both cultural sub-constructs, Culture-Specific Beliefs and Values and Technology Culturation, might have a moderating effect on ICT Transfer Implementation. In other words, beliefs and values and culturation might affect the effectiveness of ICT Transfer Implementation, in addition to their direct effects on ICT outcomes:

Besides the hypothesized direct link between CULTURE and/or [Technology Culturation] and [Information Technology Transfer], there may well be a moderating effect on transfer implementation factors .... It is conceivable, for example, that Arab sensitivity to authority may strengthen the influence of top management support on successful outcomes. As a further example, training may be far more effective when trainees have been technologically culturated, or previously exposed to similar systems originating abroad. (Straub 2001)

In line with these propositions, we include the following hypotheses in our model:

Hypothesis 4a: Power distance between managers and subordinates will dampen the effect of better ICT transfer implementation, thus (i) reducing the capabilities of e-business and (ii) reducing the value of e-business outcomes in developing countries.

Hypothesis 4b: Uncertainty avoidance in business decisions will dampen the effect of better ICT transfer implementation, thus (i) reducing the capabilities of e-business and (ii) reducing the value of e-business outcomes in developing countries.

Hypothesis 5: Exposure to business ICTs from advanced nations will enhance the effect of better ICT transfer implementation, thus (i) further increasing the capabilities of e-business and (ii) further increasing the value of e-business outcomes in developing countries.

METHODOLOGY

In order to focus and obtain meaningful results, we restricted the scope of our study in a number of important ways. First, rather than looking at developing countries in general, we have chosen to focus on Latin America and Sub-Saharan Africa. These are some of the regions that have less prior research focus regarding e-business, and we believe are in greatest need of such research. Thus, we are conducting our study in two phases, each examining e-business in one of these two regions.

In order to be more focused in our responses, we restricted the scope of this study to small and medium enterprises (SMEs) in urban centers. We were interested on the effect of e-business on locally owned organizations, and we realize that e-business is insufficiently developed at this time in rural areas.

We administered the questionnaires using World Wide Web, paper, and electronic document versions, and distributed the questionnaires to respondents via World Wide Web, regular postal mail and e-mail, respectively. Guided by the theoretical understanding we obtained from our literature review, we combed the pertinent literature carefully to identify questionnaire items that are pertinent to our study of e-business in developing countries (Bingi et al 2000; de Vreede, Jones and Mgaya 1999; Hasan and Ditsa 1999; Hofstede 1980). Borrowing from and adapting items used in these studies, we developed multiple-item measures for each item. We pilot-tested and refined the instrument on a subset of our final sample. Details on the full instrument are available at http://chitu.okoli.org/mis/research/dissertation/dissertation.html.

Phase 1 Results: Sub-Saharan Africa

For the first phase of our study, we used two databases of experts in African ICTs. First, we obtained contacts from a database of 1,253 organizations from the African Information Society Initiative (AISI), a project sponsored since 1996 by the United Nations Economic Commission for Africa. Our second African data source was the database of experts provided by the African Research for Information Society Emergence (ARISE), a project sponsored since 2002 by the International Development Research Centre of Canada. The particular focus of this database is on "African professionals, researchers and activists concerned with the social issues involved in building the Information Society in Africa." From this list we obtained the names and e-mail addresses of 196 such experts.

We used the 896 AISI contacts left after conducting the pilot study and all the contact from the ARISE database, totaling 1,092 expert contacts. We received 158 completed responses, giving an effective response rate of 22.0%. After cleaning the data, we were left with 147 usable responses.

Half of the experts (50.3%) were from commercial organizations, with the rest evenly divided (15.9 to 17.2%) among nongovernmental, academic, and governmental organizations. The experts had an average of 6.7 years of experience in e-business regarding Sub-Saharan Africa. They had lived an average of 21.1 years in SSA, and 7.1 years in technologically-advanced countries outside the continent of Africa. The median and mode age group for respondents was from 35-44 years. The median and mode of highest education level attained was a master's degree. 89.0% of respondents were male.

Testing and Refining the Measurement Model

There are four steps involved in testing and refining the measurement model; that is, the part of the model that ensures that measurement variables correspond to their theoretical constructs (Chin 1998): confirmatory factor analysis, checking for cross-loadings, reliability measures of the constructs, and discriminant validity. Confirmatory factor analysis (CFA) ensured that, in a factor analysis of all the items in the instrument, each item loaded on the construct to which it is theoretically assigned. Next we verified that no items cross-loaded on a construct other than the one for which it is theoretically specified. Then using composite reliability (r_c) scores and the average variance extracted (AVE), we confirmed that the remaining constructs were reliable measures of their respective constructs. Finally, we tested for discriminant validity by examining the correlations between the latent factor scores of each construct in the model; we concluded that all constructs in the model were indeed distinct from each other based on testing the square roots of the AVEs.

Testing the Structural Model and Hypotheses

We used PLS Graph 3.0 to test all these hypotheses, and in this section, we report the PLS results that we obtained while testing the main structural model that directly tests the theorized hypotheses. We used the methodology that Chin (1996) presented for testing interactions using PLS. We normalized each variable in the cultural model (E-Business Capabilities, E-Business Value, Transfer Implementation, Power Distance, Uncertainty Avoidance, and Technology Culturation) by subtracting the mean from each data point and dividing by the standard deviation. Next, we created three new interaction constructs by multiplying the value of each variable in the constructs proposed to interact with each other. Thus, we had three new constructs: TIxCPD with 5 x 3 = 15 variables, TIxCUA with 10 variables, and TIxCTC with 15 variables (TI is Transfer Implementation, CPD is Power Distance, CUA is Uncertainty Avoidance, and CTC is Technology Culturation). We incorporated these interaction constructs into the cultural model and conducted our PLS analysis, interpreting our results as usual.

Table 3 displays R^2 for the two endogenous e-business constructs. The exogenous factors explain 22.3% of the variation in E-Business Capabilities and 24.6% of E-Business Value. This is an average explanation of 23.4%. Both R^2 values are statistically significant ($p < 0.001$). Table 3 displays the coefficients for all hypothesized paths in the model with their significances (obtained by bootstrapping).

Table 3. Path coefficients and R^2 for cultural model

Predictor Constructs		Predicted Constructs	Path	*t*	p(*t*)
Transfer Implementation	→	E-biz Capabilities	0.328**	3.079	0.002
	→	E-biz Value	0.354***	3.736	0.000
Power Distance	→	E-biz Capabilities	-0.138	-1.477	0.142
	→	E-biz Value	-0.028	-0.276	0.783
Uncertainty Avoidance	→	E-biz Capabilities	-0.090	-0.866	0.388
	→	E-biz Value	-0.117	-1.254	0.212
Technology Culturation	→	E-biz Capabilities	0.036	0.410	0.683
	→	E-biz Value	0.021	0.228	0.820
TIxCPD	→	E-biz Capabilities	-0.077	-0.615	0.540
	→	E-biz Value	-0.184	-1.215	0.226
TIxCUA	→	E-biz Capabilities	-0.034	-0.311	0.756
	→	E-biz Value	0.200	1.537	0.127
TIxCTC	→	E-biz Capabilities	-0.089	-0.621	0.536
	→	E-biz Value	-0.086	-0.602	0.548
			R^2	*F*	p(*F*)
		E-biz Capabilities	0.223***	10.171	0.000
		E-biz Value	0.246***	11.551	0.000

In addition to testing all the constructs and interactions in the cultural model together, we tested each interaction individually to ensure that the related cultural constructs in one model were not masking the effects of any interactions. That is, we tested three further PLS models: The first had Transfer Implementation (TI), Power Distance (CPD), the TI-PD interaction (TIxCPD), E-Business Capabilities (EBC) and E-Business Value (EBV); the second had TI, Uncertainty Avoidance (CUA), TIxCUA, EBC, and EBV; and the third had TI, Technology Culturation (CTC), TIxCTC, EBC, and EBV. However, as Table 4 shows, none of these interactions was statistically significant. Figure 2 displays the structural path diagram of the cultural model with the coefficients of paths that were statistically significant at the 0.05 level.

Table 4. Path Coefficients in Three Cultural Interaction Models

Predictor Constructs		Predicted Constructs	Path	*T*	p(*t*)
TIxCPD	→	E-biz Capabilities	-0.015	0.933	0.352
	→	E-biz Value	-0.104	1.013	0.313
TIxCUA	→	E-biz Capabilities	-0.093	0.909	0.365
	→	E-biz Value	0.104	1.019	0.310
TIxCTC	→	E-biz Capabilities	0.116	0.980	0.329
	→	E-biz Value	0.145	0.339	0.735

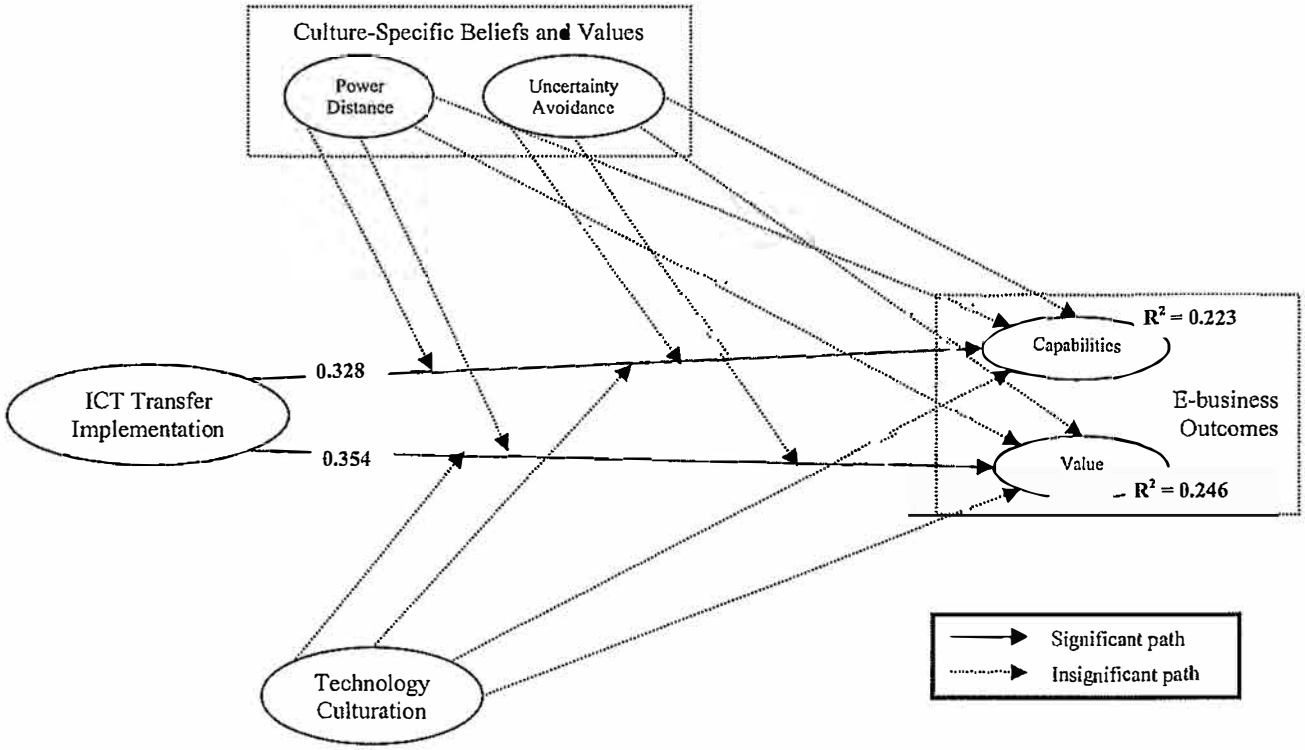

Figure 2. Cultural model of e-business factors with coefficients of significant path

In summary, our tests show that experts perceived that well-managed ICT projects (H1) would help improve specific capabilities (path = 0.328) and result in more valuable yields from e-business (path = 0.354). However, the tests did not find support for any of the cultural hypotheses. Whether regarding e-business capabilities or the value of e-business, experts did not believe that power distance (H2a), uncertainty avoidance (H2b), or technology culturation (H3) affected e-business outcomes in any significant way. When we tested the interaction between each cultural factor and transfer implementation (H4a, H4b, and H5), we did not find any statistically significant effects, indicating that the experts saw no relationship whatsoever between the cultural factors we tested and e-business outcomes.

Discussion of Phase 1 Results

ICT Transfer Implementation

The study provided strong evidence that experts perceived that well-managed ICT projects would increase the capabilities of e-business in Sub-Saharan Africa, and that this e-business activity would be profitable. This finding is consistent with those from the ICT implementation literature, one of the oldest streams of research in information systems. This indicates that the experts believed that the traditional factors that contribute towards success in ICT projects—top management support, user involvement, project championship, and so on—were also applicable to e-business projects in SSA. This is particularly important in this study, since researchers developed these theories under Western models of ICT development and this study was conducted in an African context, which a number of studies have shown can be rather different from the Western context (de Vreede, Jones and Mgaya 1999; Hasan and Ditsa 1999).

Culture

In light of the strong effects of ICT transfer implementation, it is striking that none of the cultural factors—or interactions—we tested proved to have any statistically significant effect on either e-business capabilities or value. This finding is contrary to that of Hasan and Ditsa (1999), who found that high power distance among West African business managers made them reluctant to solicit technical advice from their qualified subordinates and consequently resulted in project failures. However, their finding that West African managers' propensity to

take on risks (that is, low uncertainty avoidance) led to their taking on more ICT projects, but these projects often failed for other reasons. We would not expect that taking on risky projects—especially based on poor judgment—would have a consistent effect on either e-business capabilities or value; so, an insignificant effect is not surprising for this dimension. Perhaps a similar finding is de Vreede et al's (1999) finding that although the high power distance of East African managers did not reduce their use of groupware, it did reduce their faithful use of the democratic decision-making features of the system. Such an effect would not necessarily increase or reduce either e-business capabilities or value.

Regarding technology culturation, Straub et al (Straub 2001) found that Arabs' culturation to the technology of advanced nations, particularly by traveling to these countries, affected their perception of the success of Western-based information systems. However, although e-business is a Western innovation, the experts we surveyed did not believe that technology culturation (operationalized the same way as for Arab nations) had any effect on e-business capabilities or value in SSA.

Although different from Hasan and Ditsa's, our findings are consistent with one significant study from the literature. In an in-depth case study of the impediments to ICT diffusion among the Yoruba ethnic group of Nigeria, Korpela (1996) rejected the hypothesis that culture had any significant effect. His alternative explanation, citing the effects of historical political economy, had more in common with ICT implementation factors than with culture. He recommended that "systems analysis should be extended from the information flow within the end-user organisation to the services provided by the organisation to the civil society" (p. 39), and that African systems development projects should mobilize adequate resources, including management consultancy. Thus, the experts we surveyed concurred that the proper implementation of the e-business project itself is more important than the culture of those implementing it. Although what makes for "proper" implementation might be culturally relative, the items that we used in operationalizing transfer implementation seem to be common across both in SSA and in Western nations.
Qualitative user responses to the survey are available at
http://chitu.okoli.org/mis/research/dissertation/dissertation.html.

Outline of Phase 2: Latin America

We will similarly survey e-commerce and ICT experts from Latin America (LA). We have identified some appropriate sources, with potentially 150 or more final respondents. The experts in this database include the same categories discussed above, as this organization collaborates with other NGOs, governments, universities, and other public and private institutions.

Using the instrument developed as a result of our pilot study, we will follow the same procedure of data collection that we used for the SSA phase of the study. We will use the World Wide Web, paper, and electronic document versions and distribute the questionnaires to respondents via e-mail.

We will repeat the four steps of testing and refining the measurement model (confirmatory factor analysis, checking for cross-loadings, reliability measures of the constructs, and discriminant validity) with the LA data, checking for possible differences from the refined instrument for the SSA tests. We will use the same PLS techniques to test the same structural model with interactions. In addition to testing LA separately, we will also test the model using all the data together.

CONCLUSION

This paper outlines an investigation into experts' assessments of the pertinent factors affecting e-business in Sub-Saharan Africa (phase 1) and Latin America (phase 2). To answer our research questions, we first reviewed the literature related to e-business in developing countries and then developed a cultural model. For empirical insight into our research questions, we designed and conducted the first study that empirically solicited information from business practitioners, government officials, NGO officials, and academics that had expertise related to e-business among urban SMEs in SSA. We used the survey responses to test the research models and to help answer our research questions. We are about to begin data collection for phase 2 on Latin America.

The SSA results give cause to question the common argument that native culture significantly affects the adoption of ICTs (de Vreede, Jones and Mgaya 1999; Hasan and Ditsa 1999; Straub 2001). Most of the literature on ICTs and culture make this argument, and there have been empirical findings to this effect, but there has also

been the argument that while culture might color the way ICTs are used, it is not the prime determinant of specific outcomes (Korpela 1996). It is important to note that we cannot and do not make any conjectures about the possible effects of other cultural dimensions that we did not test in this study, such as long term orientation, social collectivity, or valuation of "the good life" (Hofstede's Masculinity/Femininity). However, the dimensions that we tested here—power distance, uncertainty avoidance, and technology culturation—have been clearly shown elsewhere to be relevant dimensions in similar contexts (Shore and Venkatachalam 1996; Straub 2001); they were not randomly selected. By presenting evidence that experts do not believe that these cultural dimensions have a significant effect on e-business outcomes in SSA, we provided quantitative evidence that reproduced Korpela's contrarian conclusion.

The next step is to test the cultural model within specific regions outside of SSA. This study will extend our research to Latin America. It will be very interesting to see what the results would be in this other developing region, whose culture is quite different from that of SSA. If the results are the same, it would provide strong evidence against the common argument that "native culture" impedes technology diffusion. However, if LA experts in e-business indicate that culture *is* a significant factor, then many insights could be obtained by analyzing the specific qualitative comments that the SSA and LA experts give to further understand what might give them different perspectives on the effects of culture on e-business in these regions. Regardless of the results, the completion of this study promises to provide interesting and valuable results.

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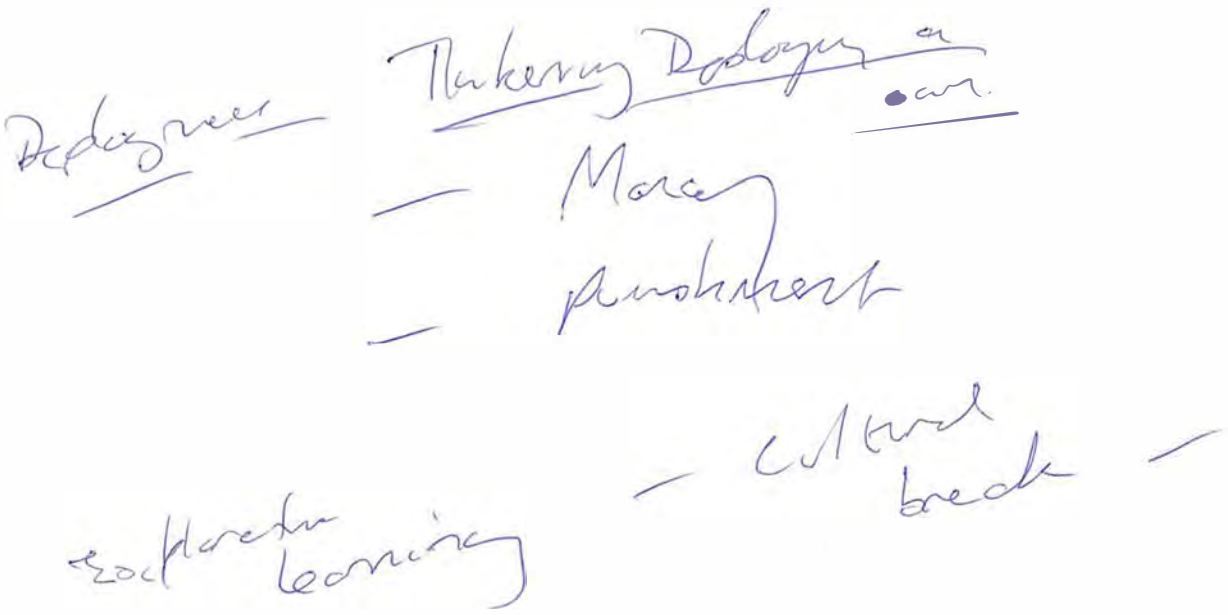

SESSION B2: RESEARCH-IN-PROGRESS PAPERS

Discussion of the Representation of Relationships under the Aspect of Hierarchic Structure and Power in a Computer Project in South-western Uganda

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ABSTRACT

In the last few years ICT projects in DCs have gained tremendously on importance. Since the late seventies conferences on Information and Communication Technology (ICT) in developing countries (DCs) have been held and literature about projects configuration and implementation has been published. Nevertheless there has been a ***lack of case studies in general*** *and especially of* ***case studies dealing with teaching computing*** *in least developed countries. So far there has been no* ***case study performed by scientist with practical experiences*** *in computer projects.*[xii] *This case study describes a computer project that was undertaken at a primary school in South-western Uganda, in the year 2002. During the project implementation one of the authors encountered - in parallel to technical problems - several misunderstandings related to culture. It became apparent that the participating people from that region approach new technology differently than we do (in the mind of members of different cultural backgrounds) and therefore integrate knowledge in a different way. This research will outline the social function of computers among the regions' population and discusses the social interrelationship between computers, teachers, donors and pupils and the reigning hierarchic positions. The overall goal of this research is the development of guidelines for a successful and sustainable technology transfer. The basis of this research project was laid during a further stay at the school in July 2003, where systematic data was collected and material was gathered. This empirical part was conducted with a view to qualitative research in the field of intercultural studies*[xiii] *social semiotics*[xiv] *and socio-scientific hermeneutics*[xv]*. Geertz's guidelines will be used for the interpretation of the participant observation and other relevant meta-documents about the project. All this empirical data enables the authors' systematic analysis done with Witzel's method of interpretation and the means of semiotic analysis. Up to the current state of analysis the cultural expectations towards gaining control over technology, such as computers, were seen as to be represented in a non explorative way of teaching. This led to the assumption that the external instructors were causing a cultural break by applying explorative teaching methods. It is to be assumed that the strong hierarchic position of teachers and parents hinder the pupils eagerness to explore new technology on their own, as they have to expect sanctions like payments and/or corporal punishment, when mistakes are done. After the examination of the Ugandan case study, the further research will concentrate on comparative studies dealing with similar projects both in the near surrounding as of Congo and/or Tanzania and in different continents like India or Ecuador. By doing so, possible similarities and differences shall be revealed and posted.*

INTRODUCTION

"Ultimately, our aim must be to ensure that people everywhere have access to information technology, and can use it to build better lives, for themselves and for their children (Anna03)."

In this press release the United Nations Secretary General Kofi Annan emphasizes the importance of information and communication technologies (ICTs) for developing countries[xvi] (DCs) and was looking forward to yield new results of the "World Summit on the Information Society" in December 2003 in Geneva. This event was supposed to mirror an ongoing discussion about technology transfer from developed to less developed countries, existing since the late seventies (Gold 1978). Nevertheless, although more and more computer projects are established, there is a lack of case studies in general and especially in the fields of *teaching computers in LDCs*

and those being *performed by a former practitioner*. The study "Technological Knowledge Transfer in Least Developed Countries"[xvii] with a view to Intercultural Awareness. Depicted by a Case Study of a Computer Project in Uganda"[xviii] tries to contribute a valuable input for a successful technological knowledge transfer. This paper poses a research-in-progress report of this study and is restricted to the discussion on roles of the involved actors, their relationships and hierarchic positions. After depicting the background (see "Background-Section"), which led to this research, the authors will describe the implied questions ("Aim of Research – Section"), the applied methods (Methods-Section) and will show the constant change of roles (both the interviewees' and the interviewer's). They will then deduce that the applied explorative way of teaching computers was untypical, regarding the cultural expectations towards technology control and the manifested hierarchic positions.

METHODOLOGY

Background

In the year 2002 the ADC Austria sent fourteen computers and two computer scientists to a Primary School in South-western Uganda to install a computer room and establish a functioning network. During the period of three months, 300 people were taught and instructed in the basics of computing. In this period it became apparent that the people from this region approach new technology differently than we do (in the mind of members of different cultural backgrounds) and therefore integrate knowledge in a different way. Throughout this stay misunderstandings, as well as smaller discussions about the access to computers among the actors, led to an unsystematic documentation of relevant data, in terms of cultural, ethnological and educational.

All these experiences were written down partly immediately and partly completed in December 2002. One of the authors interviewed 28 participants of the program and used the method of participant observation in July 2003. During the stay in July 2003 systematic data collection and gathering of relevant material had been carried out. All together, 14 adults (the whole teaching and non-teaching staff) and 14 teenagers (pupils) were interviewed on the basis of Witzel's problem centred interview ("Das problemzentrierte Interview") (Witzel:1985). This method enables to integrate the interviewer's former position as a teacher and project implementer, as it is impossible to neglect context knowledge, which has been acquired during the previous project implementation. This empirical data represents the basis of this research project. While the researcher was staying at the school he explored the regional socio-cultural context as much as possible, to enable a problem centred interview appropriate to the region. The exploration of this context will serve as an additional reference for the systematic analysis of the gathered data. Additionally, the author's text about the first computer project's experiences[xix] – similar to Geertzs' suggested thick description (Geertz:1983) – is supposed to give more information about the teachers' feelings, attitudes and their experienced intercultural phenomena.

Aim of Research

The aim of this forthcoming interdisciplinary study is to concentrate on the interrelationship between computers, teachers, donors and pupils, in other words: to investigate "symbolic instruments as both structuring and structured structurals and as instruments of domination. (Bourdieu:1991:164)", as Bourdieu puts it. On the basis of the implied questions (see *Methods*), answers in the form of guidelines are elaborated that support successful and sustainable transfer of technology. These guidelines are not supposed to be a list of "Do's" and "Don'ts" but rather a list of "If-Then-Clauses" to sharpen the mind of (development) instructors implementing computer projects in least developed countries. As the comparative studies have not yet been performed, and too less data has been analysed to aggregate smaller outcomes, guidelines haven't been developed so far.

The research will elaborate on computer education in developing countries itself and the possibility of an influence by a teacher with a different cultural background shall be considered as well. The author's own experiences will also be consulted and analysed. Misunderstandings related to culture will be pointed out and guidelines to avoid them will be presented. The author will also analyse the hierarchic position of a teacher in particular, the Ugandan education system and importance of education in Uganda as a status symbol. General attitudes towards learning and teaching shall be derived and explored. Thereby this work aims to make an important contribution to the analysis of necessary factors, which are needed to realize a successful ICT project in developing countries.

To broaden the results of the first case study and the existing Kelabit (Harris:2002) and SEIDET (Scheepers:1999) studies – which are the only available academic studies dealing with computer teaching in developing countries on an individual level - further case studies are to be done by examining computer (school-) projects, both in neighbouring countries like Tanzania or Democratic Republic of Congo and in other developing countries such as India or Ecuador in 2005. This offers the possibility for comparative analysis of the results with a view to existing similarities and differences of problems among social/educational levels e.g. primary pupils in different countries.

Methods

Since this research focuses on the subjective relevance of computer and computer teaching, the selected methods are qualitative ones, because quantitative methods are unusual to the local communication structures of Uganda. Furthermore, the African tradition in transferring knowledge is an oral one and only by establishing a daily life situation as in talks, good results can be realized. Whereas Scheepers' (Scheepers1999) and Roger Harris's (Harris:2002), studies are based on the method of action research (Rapoport1970) implying the analysis during the project implementation, this upcoming research applies a different approach: the whole project is mainly analysed after its implementation process. The following paragraphs will briefly depict the processes of data collection, and interpretation.

Data collection

- *Participant Observation and Problem Centred Interviews*

The data collection process includes qualitative interviews and **participant observation**. When one of the authors himself implemented the computer project in 2002 he realized that obviously there were problems in applying and conveying the new technology. As Witzel's method of the **problem centred interviews** ("Das problemzentrierte Interview") (Witzel1985) enables the exploration of "problem areas" as "computers" seemed to be, the author has decided to apply Witzel's method for his research period in 2003. On the basis of Witzel, the problems, difficulties and particularities of the school staff and pupils in their interaction with computer teaching and computers are analysed. This method explicitly asks to gather as much context information as possible to enable the interviewer to slip his profound knowledge about e.g. the people, institution, project in the interviews. If it seems necessary to the interviewer, to illuminate special aspects in order to focus on the "problem", it is possible to stray from the interview compendium.
All together this empirical part has been conducted with a view to qualitative research in the field of intercultural studies – cp. (Geertz:1983) - social semiotics (Hodge:1988) and socio-scientific hermeneutics (Witzel:1985).

- *Comparative studies*

In addition to the first study and the available case studies of Roger Harris (Harris:2002) and Helena Scheepers (Scheepers:1999), the research concentrates on **comparative studies** on similar projects, both in the near surrounding as the Democratic Republic of Congo and/or Tanzania and in different continents (like in India and Ecuador). For these studies (between two and four shall be examined) experts will be interviewed and relevant project documents examined. By doing so, possible similarities and differences can be revealed and posted. By the application of the concept of structuralism depicted in Stegmüller (Stegmüller:1970) a structure of the Ugandan computer project will be edited and refined/validated through the investigation of the other projects. Stegmüller proceeds from the assumption that any correct structure derived from one empirical research is supposed to be valid for others. He emphasizes the importance of a homogenous structure, definiteness of used terms and robust arguments. By a disciplined, coordinated procedure and a concise language both the comparability of scientific researches is supported and increases the chances to identify the progress of knowledge (*see* (Frank:1999)).

Interpretation

Geertz's guidelines (Geertz:1983) will be used for the interpretation of the participant observation and other relevant meta-documents about the project. The transcribed interviews are analysed by Witzel's method of interpretation, as it incorporates more "interactive moments of text production" (Witzel:1985) than other qualitative methods. Some research questions are also placed in the field of social semiotics, which "is concerned with the critique of ideology and with (re-) creating the world of sign. ... The advantage of semiotic analysis lies in the fact that it is not restrained to the non-verbal part of communication, but rather elaborates on the interrelationship between the verbals and visuals in communication acts. (Pichelhöfer:2000)"

The data will enable systematic analysis in order to focus on the questions, which aroused both during the first period of project implementation and during the research phase in 2003:
(Q1) In which way does power[xx] manifest itself during computer teaching? Which signs of social function can be spotted under the various social actors, i.e. a computer teacher or a teacher at this primary school?

(Q2) In what way does the multifunctional role as an interviewer, teacher, colleague and donor influence the progression of interviews? Should and can donors evaluate such projects on their own?

(Q3) What kind of intercultural phenomena can be observed? When and how is referred to different (cultural) systems?

PRELIMINARY RESULTS: DISCUSSION OF THE ACTOR'S RELATIONSHIP AND OF THEIR REPRESENTATION UNDER THE ASPECT OF "CONTROL" AND "HIERARCHY"

The focus of these following pages is based on the attempt to explain how "control" and "hierarchic positions" were manifested and implemented in the Ugandan computer project. The first results of this case study mainly deal with the relationship between the involved actors under the aspects of power and control, the fear towards technology and the nature of relationship. To clarify the analysis I will quote text passages of one exemplary interview with a pupil (a 13-year-old girl) to undermine these intermediate results. This interview is part of the first group of analysed interviews and is exemplary. The listed examples depict typical situations, which the researcher encountered in equivalent situations several times.

The first step of analysis was to reconstruct the thinking of the informant. Such as her attitudes, her emotions and (tacit) opinions about the theme-problem "computer".

Afterwards the following criteria were applied to shift the discussion to a meta-level:

- Which authorities can be found?
- What is the role/hierarchic position of the interrogator/interviewee?
- What does "control" mean?
- What level of control is to be expected?
- What is being controlled?
- Who prosecutes the power?
- What is expected from different hierarchies – are these expectations represented explicitly or implicitly?

Actors and their Roles.

By applying the criteria it has turned out that additionally to the three main social actors involved in the computer-activities (pupils, teachers, donors), there is a further one: the pupil's parents, who can be seen as an entity of society and a representation of it's rules. When the informant is asked whether she was allowed to use the computer at home, she denies, but notes that as soon as she was taught at school she gained access to computers at home[xxi].

This offers to discuss several different relationships; meanwhile this report concentrates mainly on the relationship between the pupils and teachers and their access to computers. This enables to illuminate one of the above mentioned research questions (Q1), at least partly.

During the interviews the pupils are playing two different kind of roles. On the one hand the one of the *interviewee* and on the other hand the *"classical" pupil* who is supposed to answer questions in a formal and proper way. E.g. already at the very beginning of our exemplary interview the pupil asks: *"Are they hard?"*, referring to the not yet asked questions, which depicts her role as a classical pupil. The only thing the girl knew was that she was to participate in an interview. She is expecting to be tested. Only as the interviewer says "really don't be scared, it's absolutely no problem, anything. You have to help me. Yeah?" she slowly shifts into the interviewee's role. The informant initializes the interview in the role of the pupil, but the longer the interview is proceeding, the more often her answers seem to be the one out of an interviewee's view.

1	Interviewer:	Can you still remember when you were using it for the first time, the computer?
2	Informant :	Yes.
3	Interviewer:	How (*clack*) was it ?
4	Informant :	When you told us to go to "START"
5	Interviewer:	Yeah.
6	Informant :	Then after click there, when we saw that, when the cursor went there, then
7		we saw, "click here", then we click through "My documents", "Microsoft
8		Word", what, what, what, whaat.

Example1 (Ex1)

In Example1 the informant is reproducing the process of using the computer for the first time in the role of a pupil. She lists every single step (Ex1Line4,6-8) and can even remember the rollover text which appears when you move the mouse over the "*START*"-Button in Microsoft® Windows. During the whole interview, the interviewer uses "*Mhm.*" as a sign of giving ear to her words. Except in the mentioned paragraph the interviewer approves her initial process of reproducing (Ex1Line4) with a rather untypical "*Yeah*" (Ex1Line5), which might cause her to remain in her role of a pupil. Via this approval the interviewer himself shifts from the initial role of an interviewer to an evaluator (in the meaning of a teacher who is interrogating pupils and asking for knowledge). During this interview the *interviewer* fails to remain in his role of an *interrogator* several times and switches to the one of an *evaluator*. This is promoted by the fact that the interviewer actually is both interviewer and teacher of the child. Several times the informant switches from a free and vivid narration to special expressions, which sound as being learned by heart. We interpret these situations as a shift to the pupil's role and consider this as an insecureness towards the whole interview situation. (Ex2Line26,27).

1	Interviewer:	Wh, what else do you think is the difference between the teaching Oswald and me
2		did and (..) and others?
3	Informant:	Well, you were the first to teach us, so we were happy.
4	Interviewer	*Laughing.*
5	Informant:	And (..) ahm (.) really (emphasized)(..), when I said you were teaching us, (..) it
6		was somehow it, you seemed to made things easy for us, not like, sometimes you
7		have asked "what does this mean", when we go there, but they are just like, it's
8		what I told you to write down. So, there for you, you have to explain what the
9		word means, don't you.
10	Interviewer:	Mhm.
11	Informant:	And (*cough - singing voice*) Sometimes we get shouted at and sometimes they can
12		kick you ...(*???*) (too less voice)
13	Interviewer:	And, and, and, yeah, and, and what was the difference for example with Mr.
14		Rakat?
15	Informant:	Oho, (...) oh well, mhm, I remember one day, we increased our letters on the
16		computer and we were almost dead, he almost cut off our heads. It was like:
17	Interviewer:	Why ?
18	Informant:	That's not what I told you to do, follow
19		instructions. For us, we had just tried to copy things, it was no problem. (..) We
20		were scared. Ahm (..) And by the way, he, some things they write on the board
21		there, they write on the boarder, like first learn them and wait some day. Ok, well,
22		ahm (...)
23	Interviewer:	What did you want to say ?
24	Informant:	I seem I have forgotten what I wanted to say.
25	Interviewer:	Oh, no, it's ok. Have you wrote on the blackboard something ?
26	Informant:	Mhm, well, ok, when you are having lessons, sometimes you have to wr, write
27		down the things.
28	Interviewer:	Mhm.
29	Informant:	And sometimes we leave out the notes, some of them, like click on (..) what, what,
30		sometimes you leave out those synthesis. So when you are going on a computer
31		you somehow be mislead and will end up like in a fight but then it seams for you,
32		you have to follow your mouse and that's a bit easy, because it's not writing down
33		something you don't know how to do and writing.

Example 2 (Ex2)

It has to be stressed that the teacher's group is divided into the "Austrian teacher" (project implementer) group (AT), the "Ugandan computer staff" (UCS) group and the non-computer-teaching permanent staff. The distinction between the AT-group and UCS-group is made both by the interviewee and the interviewer. The informant addresses the interviewer/instructor with „*you*" and the other computer teachers with "*they*" (Ex2Line6-9) – this differentiation occurs on the basis of the informant's teaching experiences. The interviewer also differentiates between the UCS and himself with his (Austrian) colleague (Ex2Line1). A further characteristic of these two teacher groups can be found in the same passage, when the informant notes the difference in the way of teaching. It is to be noted that the informant demands discovering and practical teaching methods, whereas unto this stage of analysis the UCS is teaching in an authoritarian way, including corporal punishment (Ex2Line6-9). So far it seems as if the relationship between the Austrian teachers and pupils and the UCS group and the pupils is different.[xxii] Another interesting point is the depiction of Mr. Rakat, who stands as a representative of the group of computer teachers. Each time the interviewee speaks with the words of Mr. Rakat, she uses the I-form when formulating a command, instead of the possible We-form. This gives us the impressions that the rules were made by the teacher himself (Ex2Line8,18) and not formulated by a community of teachers. This underlines his strong hierarchic position.

Relationship, Control, Power.

Obviously all these actors are related to each other and by analysing the nature of the relationship it seems that these actors are subjected to different hierarchical positions. Most likely, these hierarchical positions are not limited to the access of computer, but also occur in other fields of daily life. Nevertheless, the way how the access to technology is constructed informs about the society which is applying the technology and it's social differences.

(Q1,Q3) When the informant claims that she was afraid of "spoiling" the technology (Ex3Line2) – which occurred in several other interviews – it both means that she is aware of her capability of ruining the technology and that she searches for a tactic or a solution to overcome her fears. In this interview her solution is to completely rely on the teacher's commands[xxiii] and reproduces them step by step.[xxiv] Even in the interview one year after the first contact, she is able to reconstruct her initial computer usage (Ex1Line4,6-8). Unfortunately, this reconstructing method makes it difficult to learn new ways of using the computer. Apparently the fear of "spoiling things" is greater than the eagerness to explore the technology. This states an important difference to Austrian youth who approach computers just in the opposite way (Stei1994).[xxv] To my knowledge there might be at least two reasons why the children are afraid of damaging computers: to have to pay money and/or to be punished . (Ex3Line5)

1	Interviewer:	O, o,o or how did you feel.
2	Informant :	Well, I feeled a bit afraid whether I would spoil them and they get viruses or
3		that type.
4	Interviewer:	Mhm. So that's what you had heard about, too.
5	Informant:	Yes.(.) It was like: oh my gosh, how much will I have to pay if I spoil it.

Example 3 (Ex3)

	Informant :	You find you have made a mess, a really big mess, (..) and well, some parents are
		strict they 2 find you and and give you up, they beat you,

Example 4 (Ex4)

These measurements of sanctions and (corporal) punishment are, additionally to the UCS (Ex2Line11,12) also performed by the pupil's parents (Ex4Line1,2). It is interesting that parents give their children access to

computers at home[xxvi] as soon as they are taught at school. It is unknown, if the parents crosscheck their children's knowledge.

1	Interviewer:	So did he teach you then how to use it or a bit, or?
2	Informant :	No, he said, since we haven't yet st, since we haven't yet s (*???*), learning at
3		school, well, when you learn, when you start learning, he'll let me use his.
4	Interviewer:	Aha.
5	Informant:	So now when we started, he has let me use it.

Example5 (Ex5)

Referring to the above lines (Ex5) it seems as if the fact of having computer lessons at school is reason enough to enable the children to access computers. This means that the school controls the access of technology in two ways: both at school and at the children's home. It seems that the parents, who contribute almost the whole school budget, completely trust in the schools education and quality.

Pupil - Austrian teacher

This relationship is dominated by the different rights of access to technology, which also shows the different hierarchic level. The words "*Then sometimes when, when you would copy, you would do something that we were forbidden to do,* " indicate that the "*we*" group is different from the interrogator who did things beyond an area of power. This incites to consider the teacher group superior to the children. At this point of the interview the "*we*" term could still be considered both as the pupils and as the group of teachers and pupils, but in (Ex2Line11-12,18-21) the pronoun "*we*" is used for the pupils and "*they*" for the Ugandan computer teachers. This shows that the Austrian teachers have more power when using the computer than the pupils. Until that level of analysis it is not possible to make any statement whether the AT has more, less or equal power than the UCS or permanent staff teacher.

(Q2) In addition to the above mentioned roles which the actors are playing in this interview, it turns out that in some interviews the Austrian teachers are assumed to be the donors as well. The Austrian teacher have a personal union of four roles: instructor, interviewer, donor and evaluator. Multiple roles as a researcher are problematic and have to be treated carefully during the whole process of research. To our point of view it is better to risk a possible confusion of roles than to carry out the study by an external researcher. If the case study was done by an external researcher it would demand a difficult phase of establishing trustfulness. This would lead to a more severe distortion of the results: Context knowledge would be missing, because the researcher would always remain as a formal guest and not have access to internal environment of the school. An open minded interviewer is demanded which stresses the below mentioned demands for a most careful human resource selection.

CONCLUSION

All in all we can say that during the interviews roles of the actors keep constantly changing. Both the interviewer and the interviewee slip into different roles several times which demands extra effort during the research process to avoid any role confusion. This problematic situation couldn't be avoided a priori. (Q2) An external researcher wouldn't have had that many role confusions (i.e. interviewer, instructor and evaluator), but this would mean an evaluation by an outsider and this is to be considered even more problematic, referring to trustfulness.

(Q3) At this point of time we have to stress that the explorative way of approaching computers was untypical for the people, who were taught and instructed in the basics of computing. (Q1) They were used to an authoritarian way of learning which is characterized more by formalism than by exploration. They tried to control technology first as to avoid any damages, which might be caused through its misuse. According to the above mentioned examples, the strong hierarchic position of teachers and parents could also be a reason why the pupils fear to explore technology on their own. The cultural expectations towards control finds its expression in a non explorative way of teaching, which leads to the assumption that the external instructors were causing a cultural break.

IMPLICATIONS FOR HUMAN RESOURCE DEVELOPMENT

For the future of Human Resource Development the creation of cultural awareness for "external instructors[xxvii]" to enable a more effective and sustainable technological knowledge transfers is important. If it is inevitable to avoid the assistance of an "external instructor", the instructor should be able to take over the role of a cultural broker (Aikenhead 2002) or at least know, and be aware of local different factors such as "used teaching methods/habits", "sanctions" or "involved institutions". A careful selection of instructors is obligating to assure skilled and flexible workers in DCs, as instructors as well as the computer itself are new social actors and elements in an existing social system and might cause a cultural break due to an inappropriate introduction of technology.

FINAL NOTICE

Up to now, the collected data has made possible a solid structural analysis and enabled founded statements. Currently, statements about other relationships like between teacher groups can not be done, as the data has not been analysed, yet

So far it seems, as if all above mentioned research questions can be investigated solidly with the applied methods, whereas the question on observed intercultural phenomena has to be discussed more in detail by Geertz's guidelines (Geertz 1983). The "non explorative way of teaching" is just an example for intercultural phenomena, but most likely more can be revealed during the interpretation of the participant observation, and other relevant meta-documents about the project and not yet transcribed interviews.

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Small Island Developing States as Emerging Software Exporting Nations: The Case of Mauritius

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ABSTRACT

Small Island Developing States (SIDS) have traditionally relied on a few sources of income, namely natural resources and/or tourism. Many SIDS were protected under GATT (General Agreement on Tariffs and Trade) and able to compete in a global economy. However, with the dissolution of GATT and several preferential trade agreements as well as recognition of over-reliance on select sources of income, SIDS are seeking to diversify their economies. This paper analyzes the case of Mauritius, a member of the Alliance of Small Island States, which has built up four "pillars" of the economy – sugar, textiles, tourism, and the offshore financial sector but is now looking to add a fifth pillar – IT and IT Enabled Services industries. This paper first reviews the challenges facing SIDS in today's world, and uses the case of Mauritius to see how feasible it is for SIDS to develop IT and ITeS industries. Carmel's (2003) ten factor framework which assesses new entrants to software exporting is used to assess feasibility. The key finding here is that - if the case of Mauritius can be generalized - SIDS do have the potential to develop IT and ITeS industries, although they will need to develop niche markets. For this to emerge, governments, universities and the private sector have to produce a joint and prioritized vision, and a corresponding human resource development strategy.

1. INTRODUCTION

Small island developing states (SIDS) are commonly defined as island states with populations under 1.5 million (AOSIS, 2004; Bray and Packer 1993; Commonwealth Secretariat 2004; Streeten, 1993). The Alliance of Small Island States (AOSIS) consists of 46 island states ranging from the island of Niue (population 1,500) to Papua New Guinea (population 5 million)[xxviii]. Many SIDS are facing environmental and economic challenges in today's world, some endogenous (such as remoteness and distance to market) but others introduced by the dissolution of preferential, protectionist trade agreements. In the face of these challenges, many SIDS are looking to diversify their sources of income and "upskill" their greatest asset – human capital. One such case is Mauritius, which has diversified its exports through the years from sugar to textiles, tourism and financial services. Now Mauritius has established a government policy to promote an IT and ITeS (IT enabled services, such as call centres) export industry. This paper analyzes the feasibility of Mauritius developing an ITeS industry as a SIDS. We start by outlining some of the endogenous challenges facing SIDS and those introduced by the dismantling of WTO agreements. We then provide the background to Mauritius and outline Carmel's (2003) framework for new entrants to software exporting. The framework is then used to analyze the case of Mauritius as a feasible entrant and to draw lessons learned for other SIDS considering this industry.

2. CURRENT CHALLENGES FACING SIDS

Being *small island* states, SIDS suffer from a shortage in the quality and quantity of natural resources, with a tendency to rely on a few sources of income such as sugar (Mauritius, Fiji), bananas (St. Lucia, St. Vincent, Dominica), coconut-related exports (Samoa, Tuvalu) and tourism (Seychelles, Maldives to name but a few). Secondly, SIDS tend to be susceptible to natural disasters, increasingly in a climate of global warming. Thirdly, also because of size, SIDS tend to have a small domestic market and are more dependent on foreign trade and vulnerable to external shocks (Briguglio and Kaminarides, 1993; Streeten, 1993; Lamusse, 2001; Kirkman, 2002). While foreign trade might constitute 10% of the national income of a large country, in small states foreign trade may be as high as 50% (Streeten, 1993). Fourthly, SIDS suffer from a lack of economy of scale, which constrains the ability to be competitive in international trade (Briguglio and Kaminarides, 1993; Bhaduri

et al, 1982 cited in Lamusse, 2001). Fifth, SIDS suffer from high transport costs (Briguglio and Kaminarides, 1993) because of a tendency of smaller harbours and airports, which means smaller capacity for cargoes. Linked to this, SIDS, by and large, are affected by long distances to market (Wells, 1996). Because of this time and distance to market, they may suffer delays in delivery, and therefore challenges in adapting stock quickly, as they may already have tied capital into finished products (Briguglio and Kaminarides, 1993).

On the other hand, there is also an argument in *favour* of small scale (Streeten, 1993; ITU, 2004), including improved efficiency (with the removal of layers of bureaucracy) and greater transparency, as government actions are closely followed in smaller countries (Streeten, 1993; the ITU, 2004 and Read, 2004). Having said this, Streeten recognizes there are exceptions to societal "harmony" (Fiji, Trinidad and Tobago, Solomon Islands), and that groups divided in a SIDS can be more paralyzing than in a large country (Streeten, 1993) and that SIDS make a conscious effort to keep order because they are aware of the potentially paralyzing consequences of internal rifts. On the whole, however, Streeten (1993) and Briguglio and Kaminarides (1993) point out the advantages to SIDS are the capacity to adapt quickly, to adjust to trade shocks and display greater national solidarity – the latter in particular leading to valuable strength in international negotiations (Bray and Packer, 1993; Bunwaree, 2001).

In addition to these intrinsic vulnerabilities, SIDS are facing further challenges in the wake of trade liberalization. Where previously agreements such as the EU-ACP (African, Caribbean and Pacific) Lome Convention protected some SIDS with quotas and duty free access to markets against larger-scale producers, the erosion of trade preferences under new WTO (World Trade Organization) agreements is threatening the economic stability of many SIDS. For example, under pressure from the WTO, the European Union ended its preferential treatment for importing bananas from ACP countries in 1999. As a result, export revenues from bananas in just one country – St. Lucia - dropped from $46.5m in 1996 to $21.7 million in 2002 (United Nations, 2004).

3. THE POTENTIAL OF ICTS FOR SIDS

"Communications and information technology have enormous potential, especially for developing countries" (Kofi Annan cited in Mansell and Wehn 1998, p. 1). Yet, in an era of globalization, many SIDS are on the periphery of the global economy because of their remote locations, small size and lack of human resources. For Castells (2000), the network society unites only the European Union, North America and the Asia Pacific region, while outside these networks, survival is increasingly difficult. However, the very nature of ICTs – that they cut through time and space, and rely on human, rather than natural resources – provides economic opportunities for SIDS (Gunaratne, 1997; Bunwaree, 2001; Chowdhury, 2004 (in United Nations, 2004)).

4. BACKGROUND TO MAURITIUS

The island of Mauritius (a member of AOSIS) lies in the Indian Ocean, around 855 km off the east coast of Madagascar, the nearest large landmass. It is 64 km long and 47 km wide, with a population just over 1.22 million. Colonized by the Dutch (1610), French and British successively and with subsequent immigration from India and China, Mauritian society is ethnically diverse yet politically stable[xxix]. Most citizens are bilingual in French and English and other languages spoken include Hindi and Kreol Morisyen. At the time of independence from Britain (1968), Mauritius was struggling with a rapidly expanding population, a balance of payments deficit, inflation, unemployment and an economy 95% dependent on sugar (Bunwaree, 2001; ITU, 2004). Since then, the country has won widespread acclaim for its economic and social development, achieved with investment in family planning, an export-oriented economy, a fair political and legal system, and a free press (Bunwaree, 2001; Lange, 2003; ITU, 2004). Successive governments diversified from sugar into textiles (in the 1970s), tourism and an offshore financial sector. It is estimated that the country has maintained an average real GDP growth rate of around 5% per annum over the past three decades (Dabee and Greenaway, 2001, p. 1), resulting in epithets such as the "African Tiger" (Economist, 1998) and "one of the most successful stories in the context of the African continent" (OECD, 2003, p. 3).

Mauritius exemplifies many of the challenges to SIDS described above. It has few natural resources, imports most of its food, is vulnerable to natural disasters (in particular cyclones), and has a limited domestic market. It is highly dependent on foreign capital (Bunwaree, 2001) and has a long distance to both the major countries it exports to (the United Kingdom, France, the U.S.A and Germany) as well as the countries it imports from (mainly France, South Africa, India, United Kingdom) (Mauritius Central Statistics Office, 2003).

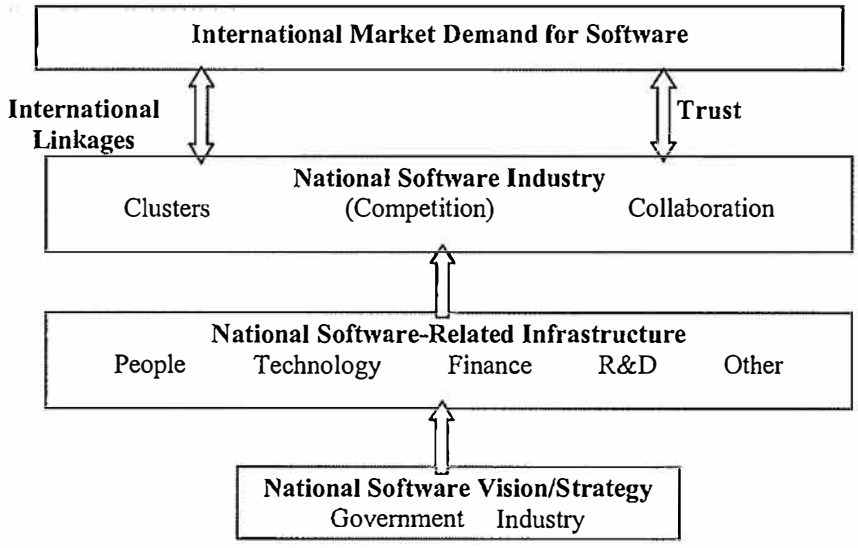
Despite diversification, textiles and sugar together still comprise 90% of exports (OECD, 2003). Yet, both are at risk - the sugar industry has been affected severely by drought (1999), and Cyclone Dina (2002) (OECD, 2003). Furthermore, the EU-ACP Special Preferential Sugar Agreement authorized exports to the EU at a price three times higher than the world price (OECD, 2003) and with an annual quota of 510,000 tons (Lamusse, 2001). However, with the dismantling of the Lome Convention in December 2004, this quota will no longer exist and Mauritius will have to compete with countries with a greater capacity for production, such as Brazil. A similar challenge exists for textiles - Mauritius had "virtually unlimited" (Lamusse, 2001) access to EU markets under the Multifibre Agreement (MFA), but with this due to run out in 2005, the industry faces competition from cheaper textile companies in Vietnam, Sri Lanka, and Madagascar.

In the face of these challenges, Mauritius has moved quickly to make IT and ITeS the "fifth pillar" of the economy (State of the Nation Report, 2000; Gopal, 2004). In November 2001, the Prime Minister declared "we have set ourselves the task of putting Mauritius on the digital map" (Ackbrally, 2002) and the Cyber Island Initiative was launched, with the aim to develop an IT and ITeS exporting industry.
As of February 2005, there were 79 export-orientated IT and ITeS companies (call centres, software development and disaster recovery), with companies including Infosys, Satyam, Microsoft, Astek, Ceridian and Cendris (Mauritius Board of Investment, 2005). How plausible is it, however, for a SIDS such as Mauritius, to enter an already competitive software outsourcing market? We now look at Carmel's framework in order to analyze the case of Mauritius and potential for SIDS.

5. CARMEL'S FOUR TIER FRAMEWORK

Carmel's framework encapsulating four tiers of software exporting nations advances on Heeks and Nicholson's (2002) initial two tiers. According to Heeks and Nicholson, the first tier comprises the 3Is – India, Israel and Ireland, three nations estimated to have exported respectively $5.1 billion, $8 billion and $2.45 billion of software between 2000 and 2001 (Heeks and Nicholson, 2002). The second tier comprises China, Philippines and Russia, with software industries between $100-$200 million for 2000-2001 (Carmel, 2003; Heeks and Nicholson, 2002). Heeks and Nicholson outlined the following success factors for new entrants:

Figure: Software Export Success Factors for Developing/Transitional Countries



Source: Heeks and Nicholson, 2002, p. 13.

Carmel (2003) introduces two further tiers – Tier Three and Tier Four – which relate to countries entering the software export industry. Tier Three countries include countries with software industries worth $20-$50m, such as Costa Rica, Mexico, Romania, Bulgaria, Brazil and Pakistan. Tier Four countries have software industries still in infant stages, which may have reached around $20 million (e.g. Cuba, Jordan, Egypt, Bangladesh, Vietnam, El Salvador) (Carmel, 2003). Carmel outlines ten success factors for aspiring Tier Three and Tier Four

nations, which are: demand; national vision; human capital; wages, technological infrastructure; software industry clusters; global, regional, geographic, cultural and linguistic linkages; industry collaboration; finance; and international benchmarking. These criteria, together with Heeks and Nicholson's original factors will be used to analyze Mauritius's move towards an IT and ITeS export industry.

6. RESEARCH METHODOLOGY

Findings are based on a literature review on SIDS, software industries and Mauritius as well as primary and secondary research in Mauritius between June and July 2004. During this time twenty-five ICT stakeholders from the public, private and NGO sectors in Mauritius were interviewed.

6.1 Demand

According to Heeks and Nicholson (2002) and Carmel (2003), domestic and foreign demand is crucial for developing a nation's software industry. Tier Three and Four countries usually experience little domestic demand due to underdeveloped markets (Carmel, 2003). Foreign demand is usually related to the specific expertise of the countries – for example, Jordan is trying to capture the Arabic-speaking IT market. Both these patterns are reflected in Mauritius. Most domestic demand is around hardware with around 70% of the IT industry catering to hardware production/supply (National Computer Board, 2004a). In terms of the international market, while it would seem that Mauritius would have very little competitive advantage, it is also aiming to capture a niche – the European and French-speaking markets. A recent study of twenty IT exporting companies by Sharma (2004) indicated that 79% of these export to Europe. In addition, the Mauritius Board of Investment survey (February 2005) indicates that of the 79 companies in Mauritius, nearly half originate from French-speaking countries, including France, Switzerland and Luxembourg.

6.2 National Vision

For Heeks and Nicholson (2002) and Carmel (2003), this is the facilitation, funding and encouragement of the industry, principally by government and influential stakeholders. In Jordan, for example, King Abdullah has been personally involved in the REACH initiative, which aims to develop a strong software industry, principally for the Middle-East region (Carmel, 2003). In the case of SIDS, if they have greater potential to display national solidarity and adjust quickly as stated by Streeten (1993) and Briguglio and Kaminarides (1993), then theoretically they have good potential to develop a strong, unified IT and ITeS export vision and strategy in a fast-moving industry.

Mauritius developed a five-year ICT strategy plan (with the acronym "SHOCKING") in 1997, with collaboration from the National Computer Board of Singapore[xxx]. However, the strategy was not implemented fully, largely due to lack of commitment to the sector, since at the time the textile industry was successful and employment was close to 100%. In 2001, the Cyber Island Initiative (CII) was unveiled, with a threefold aim: to develop infrastructure, particularly the creation of a Cyber City; to develop human resources; to use ICTs in e-governance.

The CII has met with limited success. Even though infrastructure is now available, lack of human resources remain a serious concern. Efforts at creating requisite skill base lack focus and there are no clear employment opportunities. The SchoolNet and eGovernance initiatives have faced a lack of funds and inadequate government commitment. Secondly, the disjuncture between the first and second IT strategies has invited criticism. The ITU, for example comments that "a strategic overall plan for the ICT sector is lacking" (ITU 2004, p. 45). The key weaknesses in the national vision of Mauritius is a lack of coherence and lack of active government commitment.

6.3 Software Industry Clusters

Industrial clustering is said to bring benefits such as cheaper infrastructure, exchange of knowledge and information, and a raised profile (Heeks and Nicholson, 2002; Carmel, 2003). In a SIDS, this may be less important, again due to smaller scale. Nonetheless, Mauritius has established technology parks in Terre Rouge, La Tour Koening, and now in Ebene. The latest development in Ebene – the Cyber City - has been a key initiative of the CII. The Cyber City is the first of three more intended software parks across the island, built

with a $20m line of credit from the Indian government (part of a $100 million loan for developing the software industry overall). Officially opened in July 2004, the Cyber City houses a twelve storey "Cyber Tower" and includes a commercial and "knowledge zone" where tertiary and vocational institutions are invited to establish themselves. At the time of research, thirteen companies had signed occupancy leases, the majority focused on call centres, disaster recovery and maintenance. These include companies such as Astek (a French BPO), Ceridian Centrefile (a multinational Payroll management firm), Cendris (archiving and data capture), and Infinity (a French-Mauritian BPO joint venture). A second Cyber Tower has also been planned.

6.4 Human Capital

As Carmel comments, skilled, experienced human capital takes years of national investment. While human capital is the strongest and most flexible asset that SIDS possess, it is the lack of experience that is a disadvantage for SIDS. Mauritius is investing in human capital for the IT and ITeS industry in several ways. Firstly, the Mauritius Qualification Authority and the Ministry of Education have jointly produced a framework that grades qualifications at seven levels. The framework, developed with the help of New Zealand's Qualification Authority, specifically recognizes practical rather than theoretical knowledge (see Table 1):

Table 1: Seven Levels of IT Knowledge

Level	Competency
1. Computer Awareness	Basic understanding. Use email and browse internet. Use printer, floppy drive, CD drive.
2. Computer Literacy	Use software, such as word processing, graphic function. Retrieve information through the internet
3. Computer Proficiency	Understand all parts of the PC. Produce documents using spreadsheet software. Use multi-media tools and create presentations. Use simple databases.
4. Computer Studies	Passed O-levels in computer studies.
5. Computing/Associate Computer Professionals	Passed A-levels in computing and completed a post-secondary certificate course in IT
6. Computer Professionals	Tertiary course of 2 years or more in IT
7. IT specialists	Have a computer science degree more than 4 years experience and be experienced either through a post-graduate degree or further experience

Source: Ministry of Education and Scientific Research (2004)

These seven levels are largely grouped under primary education, secondary education, tertiary education and the public at large. In terms of primary education, the 2001/2 budget pledged to invest 350 new computer laboratories in primary schools. 330 primary school teachers were hired in 2001 and completed a nine month ICT training course, with the aim of integrating this into the primary school curriculum. At the secondary level, ICT courses were made compulsory in 1995 and Mauritius is aiming to invest in SchoolNet for all secondary schools on the island. In terms of the public at large, the National Computer Board (established in 1996) is charged with providing IT education, which includes the provision of two hardware and software equipped "cyber coaches" which visit social welfare centres and provide basic IT training. The government's Women's Unit also offers free training in four women's centres across the island (Abercrombie, Riviere du Rempart, Floreal, Flacq) from December 2003. The training is offered at four different levels and each syllabus has been approved by the Mauritius Qualifications Authority, but the centres face teacher shortages.

However, for immediate supply to the software industry, it is tertiary education that is important. Table 2 lists the ICT education provided in the major tertiary institutions.

Table 2: ICT education in Tertiary Mauritian Institutions

Institution	Undergraduate	Postgraduate
University of Mauritius	B.Eng (Hons) Computer Science with Multimedia (2 yrs)	MSc. Information Technology (p/t conversion) (2 yrs)
	B. Ed Computer Studies (2 yrs)	MSc. Information and Communication Technology (2 yrs)
	B.Eng (Hons) Information Systems (2 yrs)	MSc. Software Engineering or Distributed Systems
	BSc. (Hons) Accounting with IS (2 yrs)	
	BSc. (Hons) Maths with Computer Science (3 yrs)	
University of Technology	BSc. Software Engineering (2 yrs)	MSc. Information Systems
	BSc. Business Information Systems	
DCDM	BSc. Information Technology, awarded by Curtin University of Australia	
	BSc. Business Informatics, awarded by Curtin University of Australia	

Source: Compiled by the authors

In order to compensate for any lack of skills, almost all the tertiary institutions form partnerships with universities abroad, for example, DCDM provides University of Warwick ICT distance-learning courses, and the University of Mauritius Computer Science Department provides split-site PhDs with the University of Lancaster. Tertiary ICT education in Mauritius suffers from a combination of factors. Firstly, there is a lack of human resources to teach IT, as salaries are higher working in industry. As a comparator, salaries for programmers (with a BSc degree) working for software export companies range from MRs 16,000 to MRs 25,000 (US$600 to US$800 a month) compared to a starting salary of US$500 to US$600 for Assistant Lecturers (with MSc Degree). Secondly, there is a lack of research environment to encourage innovation in industry. At the University of Mauritius Department of Computer Science and Engineering, only one out of twenty-one academic staff has a PhD. Thirdly, there is a lack of hybrid managerial or IT and language courses offered. Huy et al (2004) recognize this lack of hybridity a major challenge for many IT graduates in developing countries, who may have excellent technical skills but a lack of communication or management skills. Fourthly, there is a lack of resources for both theoretical and practical knowledge - computing books and online journal membership is expensive, and computer access in universities is restricted. At the University of Mauritius, there are 6000 registered students, two hundred of these computer science students, with only one hundred PCs.

Perhaps largely due to these factors, the Mauritian Ministry of Education and Scientific Research estimates that by 2005, only 3611 ICT professionals (Level 6) and 305 ICT specialists (Level 7) will be available, representing only 36% and 10% of the project manpower requirement by 2006 (Mauritius Ministry of Education and Scientific Research, 2004). At the same time, unemployment is rising on the island, illustrating a mismatch of skills available and skills needed.

6.5 *Wages*

The premise of software outsourcing rests on cheap labour. While IT and ITeS wages are increasing in India (Overby, 2004), they are still at least 40% lower than in Mauritius (Mauritius Ministry of Education and Scientific Research, 2004). This is a disadvantage for Mauritius unless it can gain a first-mover advantage in outsourcing to the French-speaking market. However, it may well face competition from French-speaking countries with lower wages such as Morocco and Tunisia in the medium-term.

6.6 *Technological Infrastructure*

Small scale geography is a great advantage in terms of technological infrastructure. Kirkman (2002) argues that many SIDS are better networked compared to other developing countries. Mauritius displays a strong technological infrastructure, as shown in Table 3:

Table 3: Technological Infrastructure of Mauritius

	2000	2001	2002	Dec 2003
Estimated population	1.193	1.205	1.217	1.228
Number of households	296, 300	305, 900	311, 300	321, 000
Fixed line teledensity	24%	26%	27%	28%
Mobile phone teledensity	15%	25%	28%	38%
Estimated household internet penetration	12%	13%	16%	18%

Source: Ministry of Information Technology and Telecommunications, 2004

Telecommunications infrastructure has been made stronger by the lliberalization of the telecom sector in 2003 and privatisation of the national carrier Mauritius Telecom along with the arrival of at least five internet service providers. All this has created some competition to bring down the telecommunication rates that were one of the highest in Africa. Mauritius is also a key node on the South Africa Far East (SAFE) undersea fibre-optic cable completed in June 2002, which links Europe, West Africa, South Africa and Malaysia, providing greater bandwidth and faster connectivity.

6.7 *Global, Regional, Geographic, Cultural And Linguistic Linkages*

Carmel (2003) states that many Tier Three and Tier Four countries are providing software services by trading on cultural linkages, for example Pakistan exports services to the Gulf, Costa Rica to other Spanish-speaking countries. Mauritius has strategically used its multi-cultural heritage in inviting support from Singapore in developing its ICT strategy, from India in terms of foreign direct investment - the Cyber City was financed by India, designed by Indians and built by Indian architects. Most astutely of all, Mauritius has offered itself as an intermediary for Indian software companies (e.g. Satyam, Infosys, Laser ITESP) to enter the French-speaking market.

Let us take the example of Infosys, the main occupier of the Cyber City. Infosys was established in Mauritius in 2003, mainly to provide disaster recovery and maintenance services. At the time of writing, it had a major contract (a $5 million project) for a French insurance company, providing maintenance, enhancement and proprietary tools. Infosys faced a typical human resource challenge in setting up in Mauritius – it established a Mauritian branch in order to exploit French language skills but could not find the requisite IT skills in the

country. As a short-term solution, it brought in nine Indian programmers to work for the French-based client from Mauritius for at least nine months. Another way it used its Indian link was in training – in 2004 it piloted a graduate training programme where the hundred highest-achieving students from the Faculty of Engineering at the University of Mauritius were sent to the Infosys training campus in Mysore, India, for a fourteen-week training course in software and management skills (from interview with Infosys).

6.8 Industry Collaboration, Vision And Specialization

Industry collaboration and vision presents coherent commitment and vision, for example in lobbying government. Although the ICT Industry Alliance of Mauritius exists, it does not appear to present a clear, coherent vision for the Mauritian software industry, other than the French and bilingual market. There are several niche markets that Mauritius could exploit – for example in combining its offshore financial services industry with ITeS and call centres, or combining with the tourist industry as a testbed for new applications, such as mobile, roaming, multimedia and wireless technology, particularly where they need testing in tropical conditions (ITU, 2004). Furthermore, post September 11th, SIDS such as Mauritius could use their very remoteness as an advantage, for example in disaster recovery. Indeed, in an interview with the head of operations at Infosys in Mauritius, it was stated that it was precisely the safety and isolation of the island that was attractive to clients as an offshore destination.

6.9 Finance

Heeks and Nicholson (2002) and Carmel (2003) comment that most countries investing in software exports have invited foreign direct investment (India, Israel, Ireland, Russia) as well as eliminating income tax for software firm employees (Romania). Financial incentives introduced in Mauritius include: removal of customs duties on hardware and software, 50% income tax reduction for IT professionals, and "SAPES" – a Scheme to Attract Professionals for Emerging Sectors - where skilled professionals (and spouses) with at least three years experience are allowed to work in Mauritius for three years and acquire property (Government of Mauritius Investment Promotion Act, 2002). The government has also established a National Equity Fund to finance large projects in IT and ITeS. In addition, the Development Bank of Mauritius has developed a soft loan and seed-corn grants scheme for small businesses, which include ICT businesses. It remains to be seen how successful these initiatives will be.

6.10 International Benchmark

Heeks and Nicholson (2002) and Carmel (2003) state that one of the barriers lesser-known software exporting countries face is that they may be seen as "distant" exotic suppliers. The Indian software industry overcame this by adopting the Capability Maturity Model, a US-based software standard. Although there was no CMM certification process in Mauritius at the time of research, association with Indian companies such as Infosys and Satyam does provide some security for prospective clients. In an interview with Infosys, one interviewee responded that while clients were slightly dissuaded by the "holiday island" image of Mauritius, the involvement of Indians provided some confidence. For the ITeS industry, while the Industrial and Vocational Training Board is looking to develop standards with advice from the Government of Andhra Pradesh in India, there is no standard benchmark. There are some individual initiatives, such as SmartStop Training Services which works with the Chamber of Commerce in Paris to train Mauritian call centres in French and European standards.

7 DISCUSSION AND CONCLUSION

The aim of this discussion was to analyze the experience of Mauritius, as a small island developing state in establishing what Carmel (2003) might term a Tier Four software exporting economy. Before entering into a deeper discussion, there are a few limitations that must be addressed. Firstly, in terms of the frameworks used by Heeks and Nicholson, and Carmel, it must be recognized that it is difficult to classify countries into a specific tier, as such categories are fluid – exports can go up or down and countries can overtake one another. Secondly, it must be recognized that SIDS vary greatly and one must be careful in generalizing from the case of Mauritius, which has a unique heritage and invested heavily in its economic and social development.

Despite these limitations, Mauritius exemplifies many of the challenges faced by SIDS as they diversify their economies and make full use of their strongest asset - human resources. If we look back at the key advantages and disadvantages facing SIDS, the development of an IT and ITeS industry would overcome the over-

dependence on natural resources, which are vulnerable to natural disasters. If most traffic in IT and ITeS services export is virtual, rather than physical, the long distance to market and high transport costs may not be as important as when exploiting natural resources or producing manufactured goods. Moreover, small size, as mentioned by Streeten (1993) and Briguglio and Kaminarides (1993), may actually be an advantage, as SIDS would be more flexible, and potentially able to adjust to changes in markets. They may also be able to produce a stronger, more coherent national ICT vision and strategy, as opposed to larger countries. However, it is unlikely that they would be able to overcome the challenge of diseconomies of scale or dependence on foreign markets. Indeed, developing an IT and ITeS export sector will increase the latter.

The achievement of these potential benefits described above are subject to the criteria first outlined by Heeks and Nicholson (2002) and then in Carmel's ten-factor framework. Table 4 summarizes the achievements of Mauritius against this framework.

Table 4: Achievements of Mauritius against Carmel's Ten Factor Framework

Carmel's Ten Factor Framework for Tier Three and Four Countries	The case of Mauritius
Demand	Targeting French and bilingual (French/English) demand
National Vision	Some national vision, but lack of strong government commitment
Software Industry Clusters	Establishment of several clusters, including high-profile Cyber City and two further intended software parks
Human Capital	Lack of skilled, experienced human capital
Wages	Relatively high wages, upto 40% higher than India
Technological Infrastructure	Very good technological infrastructure, particularly with telecommunications liberalization and competition
Global, regional, geographic, cultural and linguistic linkages	Strategic exploitation of links with UK, France, India, China and Singapore. In particular, serving as a link between India and France
Finance	Raft of financial measures introduced
Industry collaboration, vision and specialization	No strong industry collaboration or specialization other than French market
International benchmarking	As yet, no Mauritian software companies are CMM certified. Initiatives to establish standards for ITeS industry are being introduced

Industry collaboration, vision and specialization

No strong industry collaboration or specialization other than French market

As seen from Table 4, Mauritius has been more successful in some areas than others in establishing itself as a Tier Four software exporting nation. Of greatest concern is its lack of sufficient skilled, experienced human capital. The Ministry of Education and Scientific Research needs to establish a strong human resource policy with clear priorities. For example, if developing IT services requires a skill-set higher than Mauritius can provide in the short-term, a priority should be establishing an ITeS industry in French and bilingual (French and English) call centres, which requires less IT knowledge and training. The latter could be provided at training institutions or on graduate trainee programmes by companies themselves, rather than under-resourced universities. A medium-term strategy would be to strengthen IT education at Levels 6 and 7, by investing in e-learning and emphasizing the development of business, project management and entrepreneurial skills. Links between universities and the private sector should be strengthened, including the establishment of R & D centres. Universities should examine and address issues relating to IT teaching, including the growth in student-staff ratios and the challenges in attracting and retaining staff. Another medium term strategy would be to combine

the IT and ITeS industry with a well-established industry in Mauritius – for example providing support for financial or tourism services, or even producing specialist IT products in these areas.

This paper has explored some of the lessons that Mauritius could share with others SIDS intending to diversify their revenue. Further research is needed on whether other SIDS may be able to invest in human capital and emerge as Tier Three or Tier Four nations. The experience of Singapore, a SIDS well known for its IT industry, should also be examined for relevance. Above all, however, it should be remembered that SIDS are not competing for large shares of the international market. In the words of one interviewee in Mauritius, "Mauritius is a small island. We are not looking to be a world leader in exporting French software services, or establishing French-speaking call centres. We simply need enough to of a market share to develop as a country. Even if we have less than five percent of the jobs created in India, that would be enough to sustain the Mauritian economy." The key question is whether Mauritius, or any other SIDS, would be able to achieve this critical balance.

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Appendix: List of small island states

Members		Observers
Antigua and Barbuda	Marshall Islands	American Samoa
Bahamas	Mauritius	Guam
Barbados	Nauru	Netherlands Antilles
Belize	Niue	U.S. Virgin Islands
Cape Verde	Palau	
Comoros	Papua New Guinea	
Cook Islands	Samoa	
Cuba	Singapore	
Cyprus	Seychelles	
Dominica	Sao Tome and Principe	
Fiji	Solomon Islands	
Federated States of Micronesia	St. Kitts and Nevis	
Grenada	St. Lucia	
Guinea-Bissau	St. Vincent and the Grenadines	
Guyana	Suriname	
Haiti	Tonga	
Jamaica	Trinidad and Tobago	
Kiribati	Tuvalu	
Maldives	Vanuatu	
Malta		

Push-Pull Factors in Routine Health Management Information Systems:Towards a Conceptual Framework to Evaluate, Plan and Improve the Capacity and Influence of RHMIS Actors in Developing Countries

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ABSTRACT

This is a research-in-progress paper that reports from experiences in longitudinal efforts to introduce and enhance Routine Health Management Information Systems (RHMIS) in South Africa and other developing countries since 1994, from the combined basis of a Department of Public Health university programme, at the University of the Western Cape, and the Health Information System Programme (HISP) Network, an international collaboration that includes Norway, South Africa, Mozambique, Tanzania, Malawi, Ethiopia, India and other developing countries. The authors propose a minimum infrastructural package for the viable establishment of RHMIS in developing country contexts, and a conceptual framework that draws on principles of public administration planning to evaluate, plan and improve RHMIS over time. These proposals are informed by consideration of the social nature of IS and the challenges for engendering 'a culture of information for action.'

This paper proposes a minimum infrastructural package that is necessary to operate a RHMIS successfully in a developing country. The minimum package would serve as a framework for basic assessments and evaluations of RHMIS in the context of particular developing countries. The fundamental elements of the framework are proposed herein. The paper addresses themes of the conference regarding policies on human resource development in the critical arena of public health, training to address skills gaps, strengthening the role of the public health sector, and major social and technical infrastructural problems faced by institutions in developing countries.

INTRODUCTION

Routine health management information systems (RHMIS) have been recognised as crucial elements for strengthening the overall performance of public health services provided in developing countries. As a viable alternative to unaffordable surveys and other large-scale data generation techniques, RHMIS are often viewed as the primary (or only) means for resource-stricken ministries of health to gauge their performance in relation to the needs and aspirations of their populations. However, breakdowns in the RHMIS of developing countries are widespread and commonly attributed to problems related to:

- Insufficient skills and knowledge of human resources (WHO 1994: 19)
- Lack of an 'information culture' (WHO 1993: 1)
- Organisational and cultural mismatches (WHO 1993: 37; Anderson 1997:89)
- Content of the information system in relation to service priorities (Lippeveld, Sauerborn and Sapirie 1997: 176)
- Inaccurate data collection and processing (WHO 1994: 19; Lee *et al.* 2002: 133)
- Delays in timely flow in information from generation points to higher levels (Lippeveld, Sauerborn and Sapirie 1997: 177)
- Software design and operation (Yeh and Tsai 2001: 135-149; Heeks, Mundy and Salazar 1999: 18)
- Gaps between hardware requirements and functionality in relation to local system and human resource capabilities (Sandiford, Annett and Cibulskis 1992: 1083)

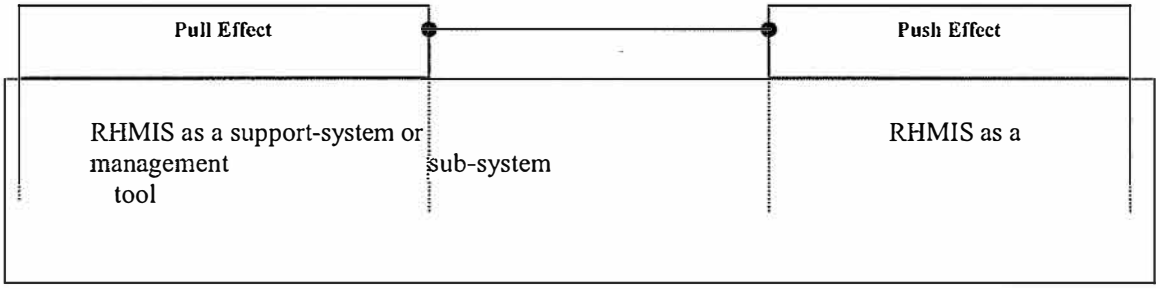
• Combinations of the limits above (Heeks, Mundy and Salazar 1999:1-21, Lippeveld, Sauerborn and Sapirie 1997: 183)

Unfortunately, functions inadequately performed by specific staff cadres are often blamed or singled out as the main culprit for ineffective operation of RHMIS. Therefore, staff involved in the operation of the RHMIS are often subjected to repeated training attempts with little result. This is largely as a result of the absence of a comprehensive framework that considers a minimum infrastructural package for the smooth working operation of a RHMIS; the absence of an adequate framework leads in turn to skewed or limited perspectives amongst actors seeking to address the situation. This paper proposes a comprehensive framework with particular emphasis on the need for developing and aligning the perspectives held by actors in the public health arena, who are reliant on RHMIS, such: as donor organisations and their implementing bodies and/or agencies; management officials involved with RHMIS in ministries of health; district personnel whose work is vital to the RHMIS; academic institutions; and researchers and consultants. Experience has shown that strengthening all elements in this infrastructural framework can create a conducive environment with tangible results for the further empowerment and development of staff involved in the RHMIS of developing countries.

THE FUNDAMENTALS: PUSH-PULL EFFECTS IN RHMIS

In its simplest form, an information system must have two internal forces, a *pull* effect and a *push* effect. Figure 1 represents these:

Figure 1. Push-Pull Effects in RHMIS



It has been mentioned *ad infinitum* that the existence of any RHMIS is for the purpose of informing plans, evoking decisions and directing the actions of managers (Haywood and Rohde 2002: 35-41). Hence, good practices in managing health services are underpinned by the quality and relevance of the information on which the decisions are based. By implication then, managers must request relevant information that they need; thus, *a continuous pull effect arises*. In other words, the information needs of managers pull on the RHMIS to satisfy needs that arise for enabling sound management. In order for managers to affect this *pull* on the information system, two important requirements are necessary. These are:

(1) an understanding and familiarity of the role and utility of information in health care management, and

(2) the existence of a health information system that can satisfy the arising and changing needs of the managers.

If managers do not have the capacities to use information in managing the health services for which they are responsible, they will not be in a position to realise and affect their information needs. Metaphorically, if managers have been reared in an environment where cars were not in existence, they would not have obtained a driver's permit, nor would they necessarily realise the utility of vehicles in the performance of their duties. Although this is an exaggerated example, it illustrates the point. That is to say, if managers were trained and obtained experience in an environment void of a culture of information for action that assumes the availability of reliable data and useful information, it would be difficult to realise such a culture within the culture as-it-was. Training in health information concepts and management skills, for example by the inclusion of health information elements in the curriculum of health professionals and management training programmes, represents

an important stepping stone towards engendering understanding of and familiarity with the role and utility of information in health care management (requirement (1) above).

The second requirement noted above-- the existence of an information system that can satisfy the arising and changing needs of the managers--relates to the existence of a support system (or sub-system) of the public health care system that can provide sufficiently reliable, useful and timely data and information to satisfy the pull effects arising from users of information. If the same transport example is used, one could say that the transport sub-system should be adequate to ensure that vehicles are available and functional to satisfy the transport requirements of vehicle users in the health system. This means that the fleet must be managed and maintained, as the tools (the vehicles) are used to deliver a health care management service. Similarly then, the RHMIS should be managed and maintained sufficiently to ensure that it can satisfy the pulling tension for the information (the tools), placed on it as a sub-system. To manage this sub-system requires an understanding that it needs to have the requisite elements and characteristics that comprise any other system or sub-system in the public health care context. The search for these elements may bring one then to the discipline of public administration. According to Cloete (1998: p. 175), public administration comprises six generic functions:

- Policy and policy-making
- Organisation
- Staffing
- Work Procedures
- Financing
- Controlling

If these components are sound, the RHMIS sub-system should be strong enough to support the tension of the pulling effect placed on it. However, even if the string is strong enough, it still needs to be pulling a well-balanced and smooth object that will not create too much friction in its movement. This object is then part of the second requirement of the fundamental framework proposed above, namely the 'tool' which is 'health information'--an information system that can satisfy the needs of managers in health care.

ELEMENTS OF RHMIS AS A SUPPORT-SYSTEM OR SUB-SYSTEM

If the six generic functions of public administration are used to identify the building blocks of the RHMIS as a support- or sub-system, then we can easily explain some of the breakdowns that we experience in the functionality of health management information systems. For this reason, capacity-building and enhancing capabilities of RHMIS actors in developing countries regarding these elements are crucial. Without engaging in a long explanation, the following brief descriptions and examples of the elements of public administration in relation to RHMIS are provided.

Policy and Policy-Making

Policy is the legal framework in which public services are provided. Perhaps more importantly, policy illustrates the political commitment shown by a government. If clear and specific policies relating to the RHMIS are developed and endorsed, policy provides a legal framework in which the RHMIS will operate. Some examples of guidelines from policy include: governance for all ensuing functions of public administration related to RHMIS; effective means for information officers (individuals charged with special responsibility for health information within a catchment area or other service area for which a health care organization or institution is responsible) to ensure that reporting health units (facilities, clinics, health centres, hospitals) submit data on time in the correct fashion; reasonable measures, e.g. training in supervision and feedback, for addressing non-reporting and reporting of poor quality data.

Organisation

Organisational culture can create a feeling of belonging to a community, or the opposite--alienation, disempowerment, arbitrariness of bureaucratic structures. Information producers and users are fundamentally situated in the context of the organisations in which they work. Organisation also refers to data generation and

analysis, and information flow. Regardless of the background of the information officers, they are at times expected to analyse information from diverse specialized health disciplines, provide sensible and descriptive reports, and even to produce indicators for specific primary health care (PHC) sub-systems. In addition, all managers turn to the information officers with *ad hoc* information requests as needs arise, which leads to the overloading of information officers. Typically, each manager sees his or her request as bearing the highest priority. Understanding organisational context and relations helps to clarify roles, responsibilities and interdependencies of individuals in the operation of the RHMIS.

Staffing

No sub-system can operate effectively without competent people. Health care personnel need to be formally appointed, to have the correct qualifications and/or skills, to receive sufficient and ongoing training and support for their responsibilities, and to have manageable workloads. For instance, would the development of the RHMIS in South Africa have been more uniform if all information officers had a health background? Is it fair to see that certain areas have information officers responsible for 13 to 20 facilities (reporting units) each, whereas in other areas information officers are responsible for 90 to 105 facilities without assistance? In addition, the development of staff should not only be focused on the data-handling functions contained in the information system as a management tool, but also in its management as a sub-system in relation to the generic functions of public administration (following Cloete 1998).

Work Procedures

If staff employed to manage the RHMIS do not know or are unsure about their responsibilities, they are not able to perform optimally, and therefore the RHMIS can not function adequately. The use of information and reporting should be spelled out in the job descriptions of all health workers, and responsibilities related to data-handling processes must be assigned to the correct staff levels. If work procedures relating to the RHMIS were better communicated and documented, situations would be less likely to arise where managers expect information officers (without adequate knowledge and skills) to fully analyse and interpret information. Managers themselves would be able to take on certain of the responsibilities. The gap between the development of the RHMIS and use of information for management between geographic- and administrative areas could be reduced as more guidance would be available.

Finances

Financial resources and procedures are required for the operation of any sub-system. Without the necessary financial means to accomplish objectives, the sub-system will surely be ineffective. The operation of the RHMIS is highly dependent on both material resources and skilled human resources. For instance, any RHMIS will run into problems if information personnel do not have access to a budget to maintain computerised systems, purchase or print data collection forms, provide training and reference materials, fund quarterly information review meetings, and so on. In South Africa, information officers generally do not have access to an allocated budget for the RHMIS. This leads to many problems in maintaining the computers used for the software. If the computer used for entering and storing routine health data breaks down, a manager cannot ensure that information is entered and reported on time. Being dependent on another sub-system's budget necessarily places the RHMIS second in line for scarce resources. This is particularly significant in the context of developing countries.

Controlling

Controls have to be built into any sub-system in the public health care context since accountability is the backbone to the public service in democracies. Information has a large role to play in the accountability of public officials (especially managers controlling funds), but the RHMIS sub-system must also possess some controls. The question of "who watches the watchers?" can then be asked: why not have indicators for the RHMIS or some other continuous monitoring system?

The discussion above is brief in nature and can be supported with many additional examples. It is also important to realise that all of the generic functions affect one another (Cloete 1998: 213-214). For instance, policy should be formulated regarding staffing levels and qualifications, work procedures for appointing staff and distributing responsibilities, budgeting procedures, and content of RHMIS data and reporting (such as Essential Data Sets, indicators for health priorities and services). The development of capacities of staff involved in RHMIS is necessary in regards to each and all of the elements discussed.

RHMIS AS A MANAGEMENT TOOL

Accurate and relevant information is the fundamental 'tool' used by managers in the RHMIS context. To enable its generation, collectors of data and staff directly responsible for information must push this tool to users (including themselves) by performing certain functions relating to the data-handling process and 'the information cycle' (Haywood and Rohde 2002: 35-41). Hence, data collection, data quality, data analysis, information reporting, and information use must be considered. A brief description of these is provided.

Data Collection

The first question of the information cycle asks, what do we collect? The simple answer is essential, accurate and timely data required for the management of the health system. These elements must be developed with analysis and use for action as its main reason for inclusion in the Essential Data Set (EDS). In order to do this, one must be sure that the indicators are selected based on objectively determined and confirmed priorities. (There are many ways to develop such an EDS, but these will not be discussed in this paper.) Once the data elements in the EDS have been agreed upon, data collection tools must be in existence and always available at the appropriate points of collection. These tools must have certain characteristics such as being simple, clear, cost effective, integrated, and relevant and clear in terms. They should not overlap, nor should they take too much time to collect. The EDS should be designed to ensure that little time is taken to complete it, that it can be easily aggregated, and that it will promote the collection of accurate data. In addition, collection points must remain individualised during the aggregation procedure so that data accuracy of 'raw data' from facility level can be verified and analysed meaningfully.

Data Quality

It is crucial to ensure that mechanisms and tools are in place to ensure that data are accurate. As a result, the existence and appropriateness of manual- and computerised data accuracy verification procedures must be ensured. Although work procedures, design of all tools, and training must contribute towards ensuring data quality, certain tools should be in existence to enhance data accuracy, such as minimum and maximum range values for each data element for each facility, outlier analysis tools, internal consistency checks, monthly reporting unit reporting logs (such tools are key features of the District Health Information System open source software known as DHIS). Computerised accuracy checks and manual checks must be performed on a frequent and continuous basis. Thus, the quality, existence and use of tools to check accuracy, correct errors and prevent errors from recurring must receive attention. Data transmission from point of collection must also be easily performed. Therefore, the mechanisms need to be continuously established and secured, to ensure that these steps can and do take place on time.

Data Analysis

It is crucial that accurate data are analysed to produce information. These indicators must conform to certain characteristics such as being useful, relevant, appropriate, valid, easily calculated, clearly defined, sensitive and specific. It must also be ensured that the analysis takes place at the point of collection and all higher levels

receiving the information. Consideration also needs to be given to work procedures and training related to the frequency of data analysis cycles.

Information Reporting

Reports must be clear, fulfil the needs for knowledge as they arise, and fulfil their intended purposes. Reports with relevant content based on adequate data coverage must reach all officials with the need for the information. These reports must be provided on time and cover needs throughout the administrative hierarchy by integrating all relevant elements of information. Moreover, the correct officers must produce the reports to ensure sound interpretation with the correct level of detail, coverage and quality of data.

Information Use

Information use needs to be defined and built into the design of any RHMIS. The agreed upon definition will determine what products of proof should be built into the system with the intention of enabling continuous monitoring. Such products of proof need to be unbiased and verifiable.

CATEGORISED EXAMPLES OF COMMON PROBLEMS ENCOUNTERED

Table 1 illustrates how the framework can be used to explain, and show the relations between, examples of fundamental problems frequently identified with current routine health management information systems in developing countries.

Table 1. Problems frequently encountered in RHMIS of developing countries and its relation to elements of the conceptual framework

RHMIS as Support- and Sub-System	
Policy	• Reporting units are not regulated by policy to supply routine data on time and therefore they cannot be sufficiently compelled to comply with data collection and reporting procedures. • No policy guides the number of facilities that each information officer is responsible for, therefore a skewed workload distribution results between varying geographical areas. • Policies for targets and/or objectives do not exist, therefore no national reference point exists against which to judge performance of specific areas and sub-systems.
Organisation	• Data flow is not regulated and planned to channel through a central point in the district, therefore district-level managers do not have access to all information. • When integration of information systems does not occur, this results in a situation where managers may not have access to information relevant to their needs from a different sub-system or discipline, e.g. TB and nutrition data cannot be correlated. • Information officers are inundated with requests for information from managers, with each manager viewing his or her own request as the top priority. This situation also results from a hierarchical organisational culture in which a manager is always regarded as the superior to the information officer. • The priority use of official transport by the information officer for support and training of facility staff is problematic since the support services available to the information officer are not specified and

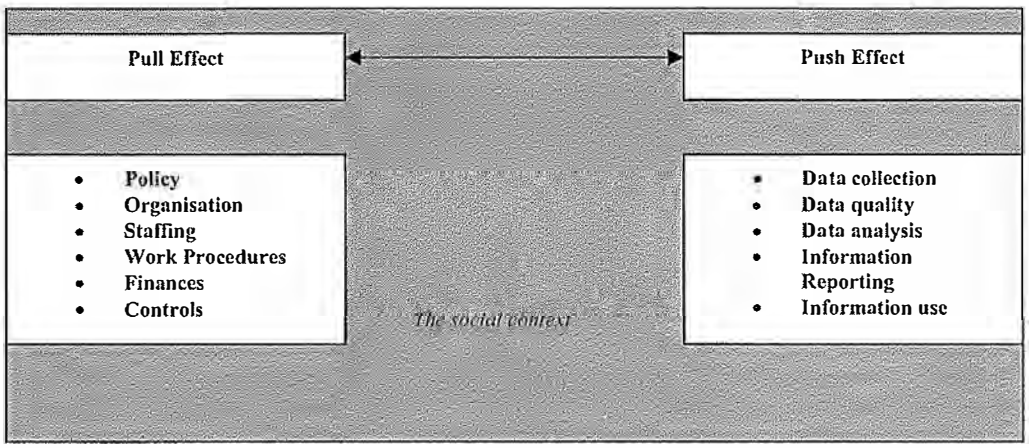
	prioritised.
Staffing	• Certain districts perform much better since they decided to employ information officers with a health background, who can more readily interpret data as opposed to other districts that opted for employing administrative staff. • Certain districts employ fewer staff, leaving them with a higher workload than neighbouring districts. • Some information officers take a long time to produce good results since they did not have adequate education skills, as this was not a prerequisite for employment to the position.
Work Procedures	• Districts may have different levels of data quality, reporting and report compilation frequencies since the work procedures of information officers have not been specified and standardised. • Information officers are abused by management and assigned unrelated duties such as preparing slideshow presentations for managers since the scope of responsibilities for information officers is undefined. • Health workers and managers do not collect and/or do not use information since their roles in the RHMIS have not been specified in their job description.
Finances	• The information officer cannot capture data since his/her computer broke down and no money has been budgeted by and for the information department for equipment maintenance. • No money exists for the information office to conduct a workshop for the revision of the Essential Data Set. • Facilities run out of data collection tools such as registers because no money has been allocated for supplies.
Controls	• The performance of information officers is variable since there is no performance appraisal system specified for the position. • Development of the RHMIS is delayed since information officers are not required to prepare strategic and operational plans for the RHMIS. • The sustained improvement of the RHMIS is not ensured since there is no existing mechanism for continuously evaluating the RHMIS system.
RHMIS as a Management Tool	
Data Collection	• Managers do not use existing information since the data elements that are collected do not reflect their priorities. • Data quality suffers because the data set is too large, troublesome and time-consuming for facility level staff to collect the data; data may be fabricated instead. • No information on finances is collected due to poor EDS development.
Data Quality	• Facility level staff report poor quality information since no accuracy checks are performed on the data and no feedback is provided to the facilities. • Data quality is not addressed because accuracy checks are not applied. • Monthly returns from data collection points are received late since the information officer has no mechanism for tracking the submission of data within reporting timeframes.
Data Analysis	• No analysis is performed since the data elements identified for collection did not consider information needs and therefore no indicators were defined for key information needs.

	• Analysis is limited in value because inappropriate indicators were defined. • Analysis has little or no meaning because no targets or benchmarks have been defined and agreed upon.
Information Reporting	• Reporting is limited because managers have not specified information needs, as they are unfamiliar with the indicators available. • Reports are not used for management purposes because they are not clear and purposefully created. • Reports are limited in value because managers assign reporting to information officers who lack sufficient skills to produce and interpret the information.
Information Use	• Managers are not required to account for the performance of the indicators relating to their areas of responsibility. • Strategic and operational plans are not linked to indicators; thus, the indicators are not reported to those responsible for health planning. • Health care staff and managers have not been trained on the utility and use of information. Therefore, they do not possess the skills to employ health information to their advantage in improving the health services.

INTEGRATING COMPONENTS OF THE CONCEPTUAL FRAMEWORK AND ITS USE

Figure 2 illustrates the conceptual framework and points to the social nature of RHMIS.

Figure 2: Integrating the Conceptual Framework & Social Nature of RHMIS



The components of RHMIS and aspects of public administration, all take place within a social context. Hence, human behaviour, organisational culture and external forces all influence the development of RHMIS. Although this paper does not elaborate on the social nature of RHMIS and external forces influencing its design and operation, the significance of a fundamental understanding of *Information Systems as social systems* is crucial to conceptualisation of the proposed framework. It is this element, the social context, which possibly assists in explaining the statement by Lippeveld, Saurborn and Sapirie (1997: 177): "It has been argued that health information systems are peculiar to the countries that develop them and thus no models can be universally applied."

Researchers, consultants, developmental agencies in the public health care sector, donor agencies and educational institutions are all involved in the strengthening and restructuring of routine health management

information systems in developing countries. Their efforts are mostly aligned with, or inform, the managerial role-players in public health organisations. Unfortunately, all of these actors often view, interrogate and focus on the strengthening of only one aspect of routine health management information systems: either RHMIS as a sub-system of the public health care system, or RHMIS as a management tool consisting of a specific array of activities, or the organisational context and its influences. Very seldom are all three factors considered and efforts focused at creating harmony between them. For instance, key actors often have one of the following specific, sometimes exclusive, perspectives towards the strengthening of the RHMIS in a developing country, associated with consequent approaches and potential problems:

Table 2. Comparative illustration of specific perspectives with consequent approaches and its resultant potential problems

Perspectives	Approaches	Potential Problems
RHMIS as merely a *sub-system* of the public health care system	Approach includes: • Provision of hardware and software solutions • Setting minimum criteria for gauging RHMIS performance that results in biased evaluation	Hardware is provided without contextually fitting the new equipment into the unspoken seniority reference framework. This leads to conflict and provokes in-fighting to gain control over scarce resources. The managerial capabilities of information staff are criticised since the focus is on individual duties, to the exclusion of also focusing on administrative infrastructure. This causes a drive towards the improvement of utilities for administration at the expense of attention to achieve accurate, high quality data and information production activities.
RHMIS as merely a *management tool*	Approach includes: • Training managers on data use for effective management of services • Training information officers on software use • Assisting in the compilation and interpretation of reports generated from the RHMIS	Managers and information staff are trained on the 'ideal' ways in which software solutions and information produced must be used to improve the management of the services. Yet, no policy requires managers to use information, nor have they ever been trained on RHMIS. Since no budget exists that can ensure that training occurs, it is not sustainable and remains

		limited to certain cadres of staff. This results in knowledge being provided to officials higher in the administrative hierarchy, whereas training does not cascade down to lower levels where information is generated.
Focus is exclusively on *RHMIS-context*	Approach includes: • Resolution of conflicting power relations within the organisation • Developing a RHMIS software solution and finding a balance between user-friendliness and flexibility	The context is described without having due regard for the possibility that the organisational context may have been as a result of the lack of consideration of the other components. The hardware and software available may not be adequate, the skills of the personnel appointed may be lacking, or the requirements placed on staff may not yet be clearly spelled out. All of these situations may lead to conflict and subsequent underutilisation of information.

Each of the main actors should use the framework for the enhancement of human resources involved in the operation of RHMIS. Table 3 describes some of these applications.

Table 3. Possible utility of the framework for different RHMIS actors

Main Actors in RHMIS Development and Strengthening in Developing Countries	Use of the Framework
Donor organisations and their implementing bodies/agencies	The framework can illustrate a comprehensive view of RHMIS to donor agencies and prevent a situation where substantial aid is channelled to a single aspect of the RHMIS, leaving other elements weak. It is important for donors to realise that most RHMIS in developing countries are weak in their totality with selective elements being dysfunctional. As a result, channelling aid to particular elements of the RHMIS may expose the weakness of the RHMIS in its entirety, rather than strengthening the overall system in a cost effective manner.
Management officials involved with RHMIS in Ministries of Health	Policy is one of the most powerful aids that can be used by managers in governmental ministries to direct efforts. It can serve as reference material to all who must enact the

	political will of the state. As a result, the framework provides a listing of aspects that need to be considered for encapsulation in policy documents. In this way, the vision of all levels of the administrative hierarchy and officials can be aligned. A comprehensive view of all the elements of the RHMIS that require administrative support is offered by this framework.
District personnel functioning as part of the RHMIS	District personnel can view themselves as an integral part to the overall district management team as the RHMIS functions similarly to any other cross-cutting sub-system (such as finance, transport, human resources and health promotion). If the RHMIS is not managed in a similar fashion as for other sub-systems, it will not be effective. Therefore, this framework is useful in that it explains all elements that need to be managed and continuously strengthened. Periodic situation analyses can be undertaken that are built around the tenets of this framework and strategic planning can be informed by its results.
Academic institutions	The training of health personnel on RHMIS is a gaping omission in many undergraduate and postgraduate training programmes offered by tertiary educational institutions. The framework refers to fundamental concepts that should be included in the curricula of all health care personnel expected to participate in the RHMIS of any developing country.
Researchers and consultants	The interplay and dependency between the various elements of the RHMIS should be recognised and promoted by researchers and consultants in the field of RHMIS. This means that the evaluation and strengthening efforts should not be focussed on specific elements to the exclusion of others. Rather, the entire basic infrastructural package should be considered and supported simultaneously.

CONCLUSIONS

The focus on RHMIS has dramatically increased over the past few years. The influence and contribution of routine health management information to the overall monitoring and evaluation strategy of ministries of health is gaining wider recognition. The result is that more RHMIS actors have emerged to influence these information systems that are currently very fragile in poorly resourced countries. Unfortunately, the contribution made by these actors is mostly oriented towards a specific perspective which results in limited effects rather than enhancing holistic capacities, potentially negative consequences, rather than enhancing holistic capacities and inter-related material, technical, informational and human resources. In order to ensure that specific elements of an overall RHMIS are not disproportionately advanced out of synchronisation with other vital elements, a suitable framework must be available to guide development assistance and donor programmes, visions for the establishment and strengthening of RHMIS, ongoing management of the RHMIS, and curricula for inclusion into

undergraduate to postgraduate courses for future and current health professionals. We argue that significant, overall improvements to structurally weak RHMIS of developing countries can only be ensured if all actors are sensitised to an overall foundational framework for the operation of RHMIS. Towards this goal, we have described and offered such a framework.

NOTE TO READERS

A user-friendly manual to conduct a situation analysis on RHMIS in developing countries at district health level has also been developed based on due consideration of the model presented in this paper. The manual is freely available from Marius Gouws, mggouws@mweb.co.za, School of Public Health, University of the Western Cape, Private Bag X 17, Bellville, Cape Town, South Africa.

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Implications of (non) Participation of Users in Implementation of the Health Information System Project (HISP) in Andhra Pradesh: Practical Experiences

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ABSTRACT

The paper problematises the participation of users in the development and use of health information systems, in the context of on-going implementation and action research within the Health Information System Project (HISP) in Andhra Pradesh, India. The case study presents the ongoing research related to the implementation of information systems for improved local control and use of information at district and sub-district levels in the health sector in Andhra Pradesh, and highlights in particular the (non)participation of users in the implementation of HIS and the implications that arise from (non)participation.

ICT POLICIES – A MACRO LEVEL PERSPECTIVE

All over the world, countries are employing the power of IT in various activities associated with running of the government machinery as well as utilizing IT in the day-to-day life of citizens. Governments are initiating various policy measures in different fields of development (biotechnology and telecommunications), which would bring change in production processes and provide citizens means of social cohesion. The resulting 'informationalism' is leading to the accumulation of knowledge with higher complexity (Bajwa 2001).

With many initiatives taking place globally in information technology, India, too, began its information era in the early 1980's. Though many IT policies and programmes were devised as far back as the early 1970's, it was the computer policy introduced in 1984 that gave thrust to software and computerization of different sectors in various departments by underlining the need for institutional and policy support on a number of fronts (Joseph 2002). The policies devised at the centre provided a favourable climate for the states to take a proactive role in the growth of IT industry. By the year 2000, many state governments including Karnataka and Andhra Pradesh, followed by Tamil Nadu and Delhi had enacted IT policies. Apart from encouraging investments and exports, these policies focus on the key issues of infrastructure, electronic governance, IT education and providing a facilitating environment for increasing IT proliferation in the respective states.

It is within this broad framework and environment for change through e-governance policy and implementation, that we present a case study from the Health Information System Project (HISP) in India, an ongoing action research project to develop and implement health information systems (HIS) for improved local control and use of information at district and sub-district levels, initiated in the health sector in Andhra Pradesh in 2000. HISP-India introduces the open source software application and database known as DHIS[xxxi] (District Health Information System) through intensive on-site and off-site training in IT skills and in concepts of HIS and *use of information for action*. Our discussion highlights in particular the implications that arise from the (non)participation of users of HIS, to underscore the critical importance of participation of HIS users at all levels of the health system, particularly, and public sector management and governance, more generally, in the context of developing countries (see, e.g. Nhampossa *et al.* 2004; Puri 2003: Puri *et al.* 2004).

IT INITIATIVES IN ANDHRA PRADESH

Andhra Pradesh is one of the states in India where different IT initiatives—the Multi Purpose Household Survey (MPHS), video conferencing (TWINS and APSWAN), and Community Information Centres (CICs)--took on a faster pace. In a short period, the state has been in the news for its innovative approach to designing and implementing an ICT-enabled strategy for e-governance, as well bringing about an IT-enabled social transformation. These different ICT-enabled initiatives are mainly aimed toward poverty alleviation among the poor and the marginalised in the rural areas (where 80% of the Andhra Pradesh population lives), providing rural populations with ICT resources in an attempt to link them to global information networks. The state ICT policy emphasises application and use of ICTs rather than IT artefacts such as computers. The aim is to enable common citizens to start using ICT applications in ways that benefit themselves. In short, the Andhra Pradesh government's aim is to enable localised technological learning by using ICT that in turn will provide the potential for ICT innovations and local entrepreneurships to develop along with the aim of empowering the marginalised.

Regarding the enhancement of human resource development through ICT, the HISP-India project focuses on capacity-building processes that create the human and socio-technical base for structural reform initiatives in the public health sector, that are meant to further the agenda of decentralisation through the decision to place the computers at the primary health centre (PHC[xxxii]) level. The project aims to improve the quality and scope of health care delivery to the rural population and to improve the overall responsiveness of the government system that will help in building a greater sense of confidence of the public in the governmental health systems.

The project aims to improve the quality of health workers' working practices through computerization of routine health information processes and also by providing tools to health workers to conduct analysis of their achievements vis-à-vis the given service targets and health indicators. The broader goal is to empower the field staff to increase their say in larger decisions that can then lead to further decentralisation. The project seeks to improve the managerial and technical capacities of the target groups through large-scale training programmes on computers, health informatics, geographical information systems, and use of information. The aims are inter-related: to provide district and state health authorities with health information of better quality and reliability for decision-making; to facilitate improvements in the quality and frequency of feedback from top to bottom of the health system; and to give more visibility to health-related issues from the periphery. For the latter goal especially, district and state health managers will be trained to use the affordances of the DHIS database to 'drill down' to the most local level of the (facility-based) sub-centre (within a Primary Health Centre) and conduct analysis based on the comparison of achievements across facilities and over time, thus creating the informational basis for more effective health delivery.

PRIMARY HEALTH CARE IN ANDHRA PRADESH: SITUATION ANALYSIS

The primary health care sector in Andhra Pradesh, which is the main interface between the community and the health sector, is fragmented and there is no cohesion between the various health departments for whom extensive data are collected at the grassroots level. The data collected by the health worker at the frontline level are sent vertically upwards with little or no feedback or support from the top, to the health worker in the field who needs the information most. Community use, feedback and feed-up are essential for a successful sustainable information system, particularly in cases of sensitive issues such as reproductive tract infection (RTI), sexually transmitted infections (STI), HIV/AIDS cases and health problems at epidemic levels such as gastroenteritis (GE) and diarrhoea. Despite this, we found little evidence of community use, feedback, or circulation of meaningful information in the health sector of Andhra Pradesh. It is at the local level that the information is available and where immediate action needs to be taken. On the contrary, information from the local level is minimally used at the top. As pointed out by Byrne and Sahay (2003), there is an urgent need to bridge the gap between service providers, whether the local government authorities or the respective government department, and the communities they serve. Communities and service providers need to share relevant information on the local situation to develop and prioritise strategies together to improve the health situation. Sharing respectful dialogue and resources between communities and service providers can produce positive and lasting improvements by creating a shared vision, goal and objective through approaches that foster equity and shared responsibility (Byrne and Sahay 2003; Byrne and Gregory 2004). The transition to an information system that is an integral part of local governance and part of a social process for development is not only a question of changing of structures and technologies but it also challenges deeply rooted values and perceptions with regard to society, technology and health care.

The quality of existing information management practices within the Primary Health Care (PHC) sector in Andhra Pradesh is extremely poor. In our pilot study, we have identified key problems that contribute to the poor quality of data being collected, and to its infrequent use. Much of the data collected is redundant. Data collected at every level are aggregated and by the time the data reach the top levels of the health system, the specific situations in the peripheral areas are completely masked. Health workers are under tremendous pressure to carry out data collection and transmission to higher levels, but once information gets to the top, it is used only minimally. Furthermore, a major portion of health workers' time is wasted in duplicating the data, as they must report almost the same data to various departments using approximately forty forms, thus leading to poor quality and fragmentation of the data. The above work is carried out at the cost of neglect of providing essential services to the community, which is the prime duty of the grassroots health worker.

Moreover, we found that there were constant problems with the PHCs such as lack of access by the community to the PHCs because of poor planning at the state level, regular absenteeism of medical officers, poor infrastructure, shortage of staff and medicines, lack of financial resources, irregular power supply, poor communication facilities and other amenities. With the exception of requiring the field staff attend routine camps to train them as to how to motivate eligible couples for sterilizations, there were no attempts at all to equip health workers with additional technological skills, develop a culture of use of information, or to enhance their capacity in decision-making at the PHC level. The structure is so bureaucratic and hierarchical that there is no means for participation of health workers even at the PHC level, while participation in the decision-making at the higher level is almost a dream. Thus, the health staff at the grassroots level were marginalized in all regards.

INTRODUCING THE HEALTH INFORMATION SYSTEM PROJECT (HISP): A BRIEF OVERVIEW OF HISP-INDIA AND THE HISP NETWORK AT GLOBAL LEVEL

HISP in India is part of a broader global initiative on health information in the developing world, which began in South Africa in 1994, and was extended to Mozambique in 1998 and to India in 2000. Currently, similar initiatives are also underway in Malawi, Tanzania, Nigeria and Vietnam (Braa *et al.* 2004). In South Africa, HISP was extended to all of the provinces during the year 1999 (Braa and Hedberg 2002).[xxxiii]

HISP in India was initiated in 2000 by the Department of Informatics, University of Oslo, Norway, in close collaboration with the Office of the Chief Minister of Andhra Pradesh. After initial discussions, Chittoor district was selected as the pilot site. During the first year, the focus was on understanding the very complex and multi-level flows of health information from the rural community to the state department in Hyderabad, the capital city of Andhra Pradesh, through the intermediary layers of the PHCs and district offices.

As the main objective of our project is to strengthen information practices within the Primary Health Care (PHC) sector with the larger aim to improve processes concerning health care delivery for the rural community, the project began initially in Kuppam, a small geographical area in Chittoor district. Kuppam is the political constituency of the ruling head of the state of Andhra Pradesh. Kuppam was thus selected as the pilot site for HISP-India for reasons ranging from its relatively small geographical area to the ability to seek support easily from the Chief Minister's office, the administrative district and the local level. Kuppam has only nine PHCs spread over five mandals[xxxiv] in the locale, which provided a manageable basis for the piloting of successful implementation.

Through our pilot study, we identified a number of key problems, beginning with the poor quality of data being collected. We found that a significant proportion of data collected is redundant. We identified more than 30 forms being used for data collection, many of which were duplicated. Through our pilot study, we reduced the number of forms being used to two. Data were aggregated at each level, and by the time the monthly data reached the district, the situations in the peripheral areas (where maximum support is needed) was completely masked. Information flows took place in only one direction, from bottom to top, and we found very limited feedback and support to the health workers in the field who need information most. The health workers are put under tremendous pressure for data collection and transmission to the top. We found that health workers may spend more than 60% of their time is oriented towards data collection and reporting. While a great many data elements are collected (more than 500 items), its use is minimal. For example, only 15 indicators are calculated. Previous work in HISP in South Africa has established that, in order for each data item to be "essential", the data collected should contribute to the calculation of at least one or two health indicators (for discussion of essential data sets, see Braa and Hedberg 2002; Braa *et al.* 2004; Haywood and Rohde 2002).

To summarize, the motivation of our project in seeking to strengthen health information practices, arises from two key reasons: (1) the significant role of health information to the overall quality and effectiveness of health delivery to the community; and (2) the poor state of existing health information practices in Andhra Pradesh. By improving the health information practices, we seek to contribute to enhancing the governance processes of the health sector.

Based on the information and interaction with the health staff and officials at various levels, strategies were devised for capacity-building of the staff, keeping in mind that users possess domain knowledge and attitudes for acquiring new skills and that what they require is the training, motivation and support to build their own capacities which will lead to empowerment. As Johnson (2000: 3) writes:

...[A]ll capacity development should be empowering. This requires that people, who are poor, i.e. lacking certain capabilities, should be recognized as key actors in their own development, rather than passive beneficiaries of transfers. As outsiders of a community we must respect the dignity of people, learn how to listen and perform a catalytic role in their own sustainable development.

Whether and how empowerment is realised depends on who is empowered and what this power is used for. Since Multi-Purpose Health Assistants (MPHAs) working at the grassroots level are the main interface between the community and the PHC, they were identified as the main targets for the training along with medical officers and other para-professional health staff.

Based on the information and interaction with the health staff and officials at various levels, it was found that as much as 60% of the time of health workers is spent on health information transactions (collection of data, collation of data in various forms and registers, and the transmission of data to upper levels of district and state). Improving these processes will then directly impact on work, and the health staff can focus more time on providing care to the community as compared to filling in endless registers that ultimately are marginal to their work of providing health care to the community. Secondly, by cultivating a culture of *use of information*, the health staff can realise the value of information to support their actions, rather than experiencing data as only fulfilling the needs of the bureaucracy. Realisation of these values, and the development of capacities to deal with information and computers, can help to provide a sense of empowerment and commitment to the health workers. In the long run, this will no doubt contribute towards improving the quality of health delivery to the community.

Thus participation in this context is considered a key issue, not only in terms of understanding existing capacities but also in developing new capacities. At the same time, keeping in view the existing political, social and economic structures, the participation of users in the design, development and implementation of information systems is hardly a simple or straightforward task but rather a highly challenging one. Moreover, the health sector in India is highly complex with many levels of hierarchy that are fragmented in different ways and directions. Targeting the users for participation in the implementation of HIS required a multi-pronged strategy. With the above perspective, training sessions for capacity-building of users were organised.

Initially, the majority of the health staff, mostly women and those working at the community level, attended the training programme. It became very clear that initially the majority of the participants in the training sessions, did not understand core concepts of HIS nor why HIS were being implemented. Rather, they participated in the training programme because there was pressure from their immediate superiors, the District Manager and Health Officer at the district and the Special Officer at the constituency level. Despite the lack of understanding or disinterest of many of the health staff, and considering the interest and enthusiasm of others (especially health workers from the most frontline and grassroots levels), the training programmes continued both 'on-site' and 'off-site'.

During these training programmes, in addition to imparting technical skills in operating computer systems and working with the District Health Information System (DHIS) software, training on use of information was also provided. This helped health staff to quickly realise that with the vast amount of data collected, information on various issues and indicators could be easily developed through simple analysis. The health workers, particularly those from the grassroots level who were keen in taking part in the decision-making related to re-setting their targets reasonably for important performance indicators (such as indicators for antenatal coverage, post-natal

check-ups, immunisation and sterilisation), and in making soundly based demands for supply of medicines and other resources to their PHCs, realised the need for decentralised information.

However, unless access to information and a culture of *use of information* can be developed, health workers have no choice but to routinely collect and collate data. Through the on-site and off-site training programmes, they realised that data collection and collation can be supported through a computer-based application and by developing an information culture for use of information for action at the grassroots and all levels.

Many health staff then began to earnestly learn to use the DHIS application and to learn how to make use of health information. Within seven months of initiating the implementation of HIS in many PHCs in Kuppam, the data were entered into the software application and regularly updated. Health workers soon realised the benefits of using the HIS which not only reduced their manual work, duplication of collecting and collating data, but also helped them to analyse both individual and institutional performance across time, indicators and facilities. Based on the initial success of the implementation of the HIS, the Commissioner of Family Welfare gave permission to generate reports using the application. Reports were designed taking the inputs of the health staff at all levels and demonstrations were given to the staff as well to the higher authorities. However, when it came to actual practice, the senior staff within PHCs and authorities at the PHC level did not participate in the use of generated reports, thus putting the whole process of implementation of the HIS at stake. In Andhra Pradesh, the health sector has selected 16 performance indicators against which the PHCs are given targets that again filter down to the field staff. These targets have been unrealistic in the sense that in the majority of the cases, they are beyond the stage that can be fulfilled realistically in the context of time and resource constraints. Instead of questioning the irrationality of targets and insisting on rational targets from higher authorities, the practice for years has been to manipulate the data, particularly at the time of collating and reporting in the formats at the PHC level. This is done mainly by the medical officers and health supervisors to escape the wrath of the higher authorities and to get good evaluations (good grades) for their institutions. Participation in the process of implementation of the HIS remained high up to the point of completing data entry, but those responsible for reporting had not yet realised that manipulation of data cannot be done when generating reports from the DHIS database. That is to say that after data entry was completed and reports were generated, both the supervisor and medical officer were shocked that the figures shown in the reports were far below the targets given by the authorities. Since the reports were printed using the application, they could not change the figures. There was no option to generate empty formats of the reports in the DHIS software and so there was no opportunity to fill in the figures manually. Soon the staff at the PHC realised that computerised reports designed with their participation did not allow them to manipulate the data as they had been accustomed to doing.

Within a short period of time, the numbers of PHCs generating reports using DHIS software dwindled. Initially they gave excuses, but soon they came with the request of developing the option in the software to manipulate the figures. Since improving the quality and reliability of data is one of our main objectives, the HISP-India team discussed the issue with the medical officers regarding how to get their targets set rationally using the information about their geographical area, population and other criteria. At the time of writing, the issues remain unresolved as the concept of decentralised information that is much spoken about, is still far behind its realisation in practice.

At present, the implementation team continues to motivate the users to complete the data entry in the District Health Information Software (DHIS) and generate their reports using the database application as the basis to then use the information to demand that rational targets be set by the higher authorities. But the users are in a dilemma. Unless the users at the higher levels of the health system participate in the implementation of Health Information Systems and join in common understandings regarding use of information to empower action at all levels, the likelihood that the staff at the field level will revert to manual systems of collecting, collating and creating manual reports looms large. Therefore, participation both at the higher and grassroots level is crucial to make the project of implementation and ongoing development of district health information systems a success.

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SESSION B3: RESEARCH PAPERS: THEORETICAL PERSPECTIVES

Social Construction of Software Customization: the Case of Health information Systems from Mozambique and India

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ABSTRACT

Debates around the internationalization and localization of software are widespread in the current context of globalization. This paper argues the need to include in these debates, the question of the process of software customization itself, which is extremely context dependent, and can influence the content of the software itself. A social construction perspective is drawn upon to make this argument, drawing upon an empirical analysis of the customization process of the same application software within the primary health care domain set in two different countries – India and Mozambique. The analysis identified four conditions that contribute to the very different outcomes in these two settings: the health sector context; the organization of the development team; the nature of the customization process; the nature of the installed base; and the question of language.

Keywords: *Internationalization, localization, customization, software, primary health care, India, Mozambique.*

1. INTRODUCTION

In contemporary times of globalization, there are increasing pressures on developers to create internationalized software that can be used in different settings (O'Donnell 1994; Howard 1993). There are two broad approaches to this problem of internationalization. One, software is developed from the outset as one to be used in varying international settings, and internationalization is incorporated as one element of the software development cycle. In the second approach, software is developed for local settings as internationalization is not considered as a pre-defined aim, but is subsequently attempted to be adapted and customized to different national situations (Braa and Hedberg 2002). In the first approach, the development process is very resource intensive as the application needs to incorporate functionalities for different languages and cultural contexts of use. Also, since the context of use is always changing, there is continued pressure for the development agency to acquire new knowledge and incorporate it in the newer versions of their application. In the second approach, while the development process is initially not so resource intensive, there are other pressures relating to individual customization efforts in each context raising the potential danger of "reinventing the wheel." A middle ground to these approaches is what Rolland and Monteiro (2002) describe as the "pragmatic balance" where the focus is to try and distinguish between context dependent and independent components, and try to globalize the independent parts and focus on the dependent parts for local customization.

However, this pragmatic balance is very complex to attain in practice as it is influenced by many aspects including the development process itself by which the software customization takes place. In this paper, we argue that understanding the nature of this social construction process of software development, for example, related to the organization of the software team, can provide insights into how the customization process of the same software application can lead to varying outcomes in different social contexts.

Our empirical focus is in the domain of not for profit and open source software related to the primary health care in developing country contexts. Challenges, similar to those around the internationalization of commercial software, and associated debates around their globalization and localization, are also to be found in the domain of not for profit and open source software. While in the domain of commercial software, research related to internationalization has been rather limited in its focus on aspects of the user interface and how it can be internationalized by changing colours, or icons and symbols (Ott 1999; Barbour 1996), the open source related research questions take on a different focus. For example, in the open source domain, prior research has examined how the beliefs and values of developers working collaboratively but in distributed settings are

manifested in software development methods, artefacts, choice of tools, and how developers in a virtual community cooperate and resolve conflicts (Elliot and Scahhi 2003).

There are at least two important contextual differences between the commercial and not for profit domains which begs different research questions. One, a majority of the research in the open source domain relates to more system related applications such as operating systems like Linux where computer experts form the development community. The development environment is much different in application specific domains (such as primary health care) where there may be a more significant proportion of "context dependent" aspects as contrasted to the system related applications. Two, the level of computing expertise in the application domain, such as primary health, is much lower than in those taking place in the traditional open source systems related domains. This difference in expertise is especially magnified within the context of developing countries.

Given this brief background, the aim of this paper is twofold. Firstly, to understand the nature of the social construction of software customization of a primary health care application in developing country contexts. Secondly, through this analysis, we seek to understand the implications of the customization process around internationalization-localization debates of open source and not for profit applications.

The rest of the paper is organized as follows. In section 2, we present some theoretical considerations arising from a social construction of technology perspective. In section 3, we present the case study concerning the customization of the same primary health care application (called DHIS) in India and Mozambique. After presenting the analysis in section 4, we present some brief implications and conclusions in section 5.

2. THEORETICAL CONSIDERATIONS

Social construction refers to the process by which social meaning becomes embedded into an object under study, be it science, technology, or other forms of knowledge (Berger and Luckmann 1967). The common-sense methods which go into the development of this meaning, and social interests which account for this process, becomes units of study for the constructivist. Technology, is not viewed as objective truth which is independent of the social world, but is seen to be shaped by social processes related to their design, implementation and use (Pinch and Bijker 1987). Social construction of technology studies have described the importance of social alliances and control (for example, Noble 1984), social groups and their frames of meaning (Bijker 1987), the use of heuristics (Van den Belt and Rip 1987) and various organizational issues (Mackenzie 1987).

Over the years, the social construction of technology approach has been applied to the analysis of information systems, and concepts such as technological frame (Orlikowski, 1992), reinvention (Johnson and Rice 1987), relevant social groups (Blonk 2002), interpretive flexibilities (Orlikowski, 1992) and unintended consequences of technology (Zuboff 1988) have been developed and applied. Early research in this domain has contributed to subsequent developments, for example, the application of Actor Network Theory to develop theoretical concepts of information infrastructures (Hanseth and Monteiro 2004).

Despite the wide acceptability of the social construction approach to IS, we believe, the potential of this has not been applied to the domain of the process of software customization. Software customization involves people and machines; both situated and distributed, practices, methodologies and tools, all linked together in a heterogeneous network that is historically and institutionally embedded. Like any other social activity the work of customizing software is situated, taking place in particular locations and times, and being performed by people who act upon their specific contexts of knowledge, tools, tasks, social networks, and their own particular histories (Tellioglu and Wagner 1999).

The social construction of the software customization process is empirically interesting to examine when the same software is customized in different national settings, for the same application domain (primary health care in our case) by different local groups of developers. This social analysis will be useful as in the primary health care domain the dominant World Health Organization (WHO) model for information systems is applied to developing countries. There is an implicit assumption made that the same application model can unproblematically be applied to different country situations (Braa et al. 2004). Such an assumption, we argue through the empirical analysis of this paper, is incomplete as it does not take into consideration the context dependent aspects of the software, which is shaped significantly also by the very process of software customization. We draw upon this social construction perspective to analyze two cases in India and Mozambique where the same DHIS application is being customized for local needs. We now present the case studies.

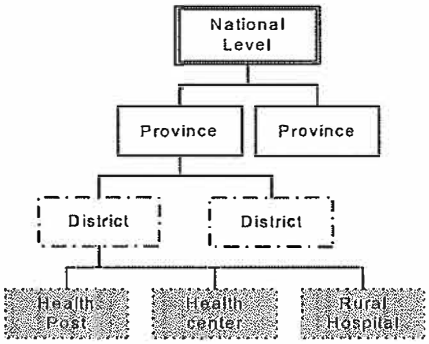
3. CASE STUDIES

3.1 Comparative context of HIS

Mozambique and India, two developing countries, are the focus on the analysis where the customization of the DHIS software under the broader Health Information Systems Programme (HISP) is currently ongoing (Braa et al. 2004). While there are similarities in the reporting structures of both countries (See Figure 1), there are important differences, for example, Mozambique has four reporting levels and India six. There are also significant differences in terms of scale with a Mozambique province having the same population level and much fewer clinics as compared to the Indian district. These contextual differences have implications on both the design and use of HIS.

There are also significant contextual differences with respect to availability of trained people (both in computers and doctors), infrastructure availability, disease prevalence and the role of donors. While India is considered as a software powerhouse in global terms (although around 90% of Indian software is for exports) with a large pool of trained people, Mozambique has barely 200 computer graduates from their local universities. In terms of infrastructure, Indian rural areas may be more stable than Mozambique, for example, related to public transport which influences the transmission of reports from one facility to the other. While both countries are dependent to a large extent on donor funds, in Mozambique where 80% of the health sector budget is comprised of external support, in India, the figure is much lower. This dependence shapes the nature of donor influence on HIS design and use.

HIS structure of Mozambique: 4 levels



HIS structure of India: 6 levels

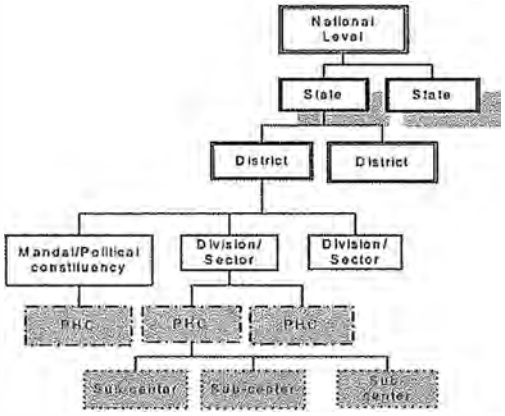


Figure1: HIS structure of Mozambique and India

After this very brief summary of some key contextual differences between the two countries, we describe their respective process of customization of DHIS from 1999 and 2000 respectively.

3.2 DHIS customization process in Mozambique

Mozambique installed a computer based HIS (called SisProg) in 1992 in all its 11 provinces and the national level. Routine health data from the districts was carried in paper forms to the province where it was entered into SisProg, aggregated and sent in electronic (floppy disks) or paper formats to the national level[9]. Despite SisProg being practically irrelevant in supporting local decision making, the system has over time become deeply

[9] See Mosse and Sahay (2003), Nhampossa (2004) and Chilundo and Annested (2003) for an overview of the kinds of problems that exist with data quality, structures of reporting, and aspects related to non-use of data.

embedded into the practices of the Ministry making it difficult to replace. It is within this context, HISP researchers comprising of staff and students from Oslo and Mozambique started attempting to customize and implement DHIS in 1999 in selected pilot districts in three provinces (Braa and Hedberg 2002).

As part of the strategy to adapt the HISP software, a multidisciplinary team was formed, composed by academicians with training in computer sciences and medicine and health management professionals working at the Ministry of health. The team members were also subsequently enrolled for the Phd program at Oslo on the assumption drawn from action research that the project work will provide the empirical basis of the research, for example, related to questions concerning technology transfer of HIS to developing countries. However, it was not possible to always find a one-one correspondence between project and research, for example, one of the team members was working on practices related to laboratories where DHIS was not involved. This mismatch, magnified by scheduling issues of people being in Norway for their studies during different time periods, meant that the team was not always well equipped to provide field level support to district offices which are relatively difficult to access (both in terms of time and money) in Mozambique.

The customization process involved dividing the DHIS software features into two categories of global and location specific which needed to be approached differently. Global features included those which could be used across contexts without prior localization, for example related to standardized reports (like missing data), indicator generator, data mart, analysis tool, etc. Changes in global features were coordinated by the South African development team, and changes required in global features identified by the local team were communicated to South Africa for action.

Location specific features such as language, data elements, indicators, local reports, lookup tables, procedures and definitions, such as reporting frequency, needed to be adapted locally by the HISP team. The issue of language translation (from English to Portuguese) was a crucial task since the entire software and relevant documentation were in English, a language not used or understood by most of the population, especially within the health sector. Since structurally, DHIS represented a front-/back-end solution in Access (Braa and Hedberg 2002), it was possible to translate and build the local database (called BACKEND) independently from the monthly data user interface (called FRONTEND). The first translation cycle involved hard coding whereby the text strings in the user interfaces were part of the code. However, since the strings were part of the code, the DHIS could not be installed in different computers, implying that the translation could only be carried out on one physical computer on which the software was initially installed. Working only on one machine meant that during a training session all the facilitators and trainees had to sit around the one portable computer that hosted the Portuguese version of the DHIS. The translation process could not be carried out on multiple machines because we were dependent on South Africa for creating the setup CD. This required that all the changes to the DHIS software were to be introduced in the same portable computer, and the physical computer along with the software was subsequently sent back to South Africa for the production of the setup CD. This was then checked by the South African team, and the validated setup CD together with the computer was sent back to Mozambique where it was further tested in the pilot districts. This cycle took place at least 8-10 times (after about a year) before the decision was taken to shift to a multi-language configuration.

The Multilanguage version of DHIS was developed in South Africa in 2001 which gave a degree of flexibility to the process of translation. Firstly, now there was no dependence on a physical computer, and translation could be carried out by the team members in parallel on multiple machines. Secondly, while the manufacturing of the installation CD was still done in South Africa (as we did not have the required tools to do so locally), on receiving the new version we did not need to delete the BACKEND as we had to do in the monolanguage system.

In general, a number of problems were faced in translating and customizing the DHIS. One of the problems being the existence of many *ambiguous data elements*. For example, the existing report formats in Sisprog included categories of "Children 0-11 months and also 0-4 years, which created an overlap. As it was not possible to change existing data items without prior approval of the Ministry, we included both and then tried to build awareness amongst the health staff about this ambiguity and how they should register data correctly. The *organizational structure* of the South African health structure, which was the starting point of the adaptation process in Mozambique, consisted of five levels, while we had four. A dummy level thus needed to be included so as to maintain the "parent-child" relationship embedded in the database structure. There were also challenges arising from the fundamental differences between English and Portuguese languages. For example, Portuguese typically needs longer words to express concepts compared to English, which had implications on the user

interface design and the use of icons. Some English words, for example "backup", do not have a literal Portuguese translation which was resolved by the creation of "hybridized" terms.

After the translation was completed, we started the process of populating the database with historical data (1997-2002) in all districts from three provinces. There were both institutional and technical challenges in this process. Institutionally, we were impeded by the fact that the Ministry did not give official orders to the field staff to use DHIS, and as a result there were both the new and old systems running in parallel. Health staff, who were already overworked, were not willing to enter the same data twice. Additional resources were not provided by the Ministry to support the pilot phase. To deal with the magnitude of the data entry task (all districts for 5 years data), we decided to automate the process by which the data from SisProg could be directly imported into DHIS. This automation process was very complex because of the nature of the "legacy systems" in terms of the outdated platforms (SisProg was built on DOS), the absence of documentation, source code, and installation disks. This meant that the work of importing data had to be done physically on the single computer of the Ministry in Maputo where the data was supposed to be stored. However, we found that the national data was very incomplete because regular updating of monthly data was not done, and we had to thus conduct this process in the Province offices where the data was more consistent and complete (See Lungo and Nhampossa 2004, Skoba 2003 and Lungo 2003 for details of this process).

The ongoing challenges of the translation process, legacy systems, and data entry meant that we put in very little effort in the automation of the routine reports that needed to be sent from the district to the province and from there to the national level. This absence of reports meant there was no visible DHIS generated information flows between the administrative levels, which made the authorities question the value of our efforts. This led to a vicious cycle where the authorities continued to be reluctant to give us official sanction for implementation and in the absence of that we could not obtain the resources and authority to "roll out." This status quo situation is currently being taken advantage of by an EU expatriate who is trying to promote an alternative (to DHIS) "idiot proof" solution which focuses on the automation of the existing reports.

3.3 Case of Andhra Pradesh, India

The process of DHIS adaptation and localization started in Andhra Pradesh, India in December 2000. Initially, the HISP team comprised of a Project Coordinator, who is an anthropologist by training, and a systems developer. As the project developed, the team was expanded and 11 other developers were recruited, all full-time, with computer science degrees, and belonging to the native state of AP. The team has been supported continuously by two University of Oslo faculty members, including one who is of Indian origin. The customization process can be described in five phases starting from a *situation analysis*, and moving through 4 subsequent DHIS versions.

Situation analysis: (December 2000-September 2001): After gaining the necessary approvals, a situation analysis was conducted in the selected pilot district (called Chittoor) over a 8 month period. The situation analysis, in addition to helping the HISP team members develop an understanding of the working of the PHC structure including its information flows, also contributed to the process of defining a "Minimum Data Set" (MDS) which made improvements on the existing datasets. These improvements, facilitated through an intensive participatory process, were in terms of reducing the number of data items (from about 1000 to 350), and categorizing the items under two main forms (for Primary Health Center-PHC and SubCentre-SC units respectively) which was a dramatic reduction from the existing 20 odd forms which were based on different programs or diseases. Our progress was presented to the State Chief Minister who provided us with permission to pilot our system in a set of 9 PHCs in one political constituency, and led to the development of DHIS "version 0."

DHIS "version 0": (Sep 2001 – Aug 2002): Initially, the organization database was created by defining the parent-child relationship between the SC, PHC, Mandal (local revenue units) and the district. The MDS forms as defined in the situation analysis (but being continuously revised based on changing needs and ongoing analysis) were then implemented in the DHIS. To be compatible with the state standard, we entered the Community Needs Assessment data exactly in the same order as it appeared on the paper form, making it easier for data entry. Two aspects of our strategy are important to emphasize. One, the data entry (from January 2001 data) was conducted by the health workers themselves (and not by the HISP team) to try and develop local capacity and commitment. We focused on identifying the routine reports that needed automation on the assumption that would lead to the health workers seeing some value of the computerization process to their own everyday work (reducing time and tediousness of their data related tasks). The identification of reports requiring automation led to the development of DHIS "version 1."

DHIS "version 1": "AP Reports" Module (Sep 2002 – Nov 2002): DHIS software came with the inbuilt feature of certain standard reports, which however were not designed for local reporting needs. We had identified some 25-30 *routine reports* being sent monthly by the PHCs to the district, some of which could be directly printed from an Excel sheet, while others varied in formats and required special customization. In addition to the routine reports, we also developed some (health related) monitoring reports that were required by administrative officers outside the health department (for example, District Collector). We also initiated the process of developing a third category of analysis *reports* for the evaluation of facility performance and the calculation of health indicators (for example, immunization coverage). The analysis reports required the database to be also populated with semi-permanent data on population, infrastructure, and facility details. All the reports were developed using the DHIS data mart as the source file containing all processed data like indicator values and calculated data elements. Reports were developed using MS Excel using Macros and VBA as it was able to provide the flexibility in report formats and was relatively easy to be used by the health workers. Since each month, multiple reports were generated, an Excel Book was created to store all reports for a particular month, which could be easily printed or (later) emailed. To enable easy access to the Excel Book, a shortcut interface was developed using MS Access called "AP Reports."

DHIS "version 2": (Dec 2002 – Feb 2003): This version included revisions to "AP Reports" and the creation of a district database. Inputs to the revision came from a senior IT officer in the state while witnessing a demonstration of version 2, which concerned organizing the reports functionary wise (for Medical Officer, for District Medical Officer etc) rather than the existing service wise organization (immunization or sterilizations report for example). Also, additional monitoring reports were included (for Special Officer, Kuppam), and also analysis reports to enable comparison of facilities with each other and over time. In January 2003, the project was extended from 9 to 46 PHCs in Chittoor District, and this raised the potential to also create a district database to give the district authorities a picture of the entire state (84 PHCs). We created a district wide database and each month, a HISP team member would collect all the data (aggregated at the PHC level without SC details) coming from the PHCs in the paper forms, and enter it into the database. This database allowed us to make comparisons between the data actually entered in the PHC with that which was sent to the district office. These comparisons were possible since we also had SC data, that was actually entered in the PHCs. Significant discrepancies were noted which were communicated to the district authorities for initiating action.

DHIS "version 3": Adding value to the DHIS (March 2003 – ongoing): With the basic systems reasonably robust and tested, we have continued to add value to the DHIS through the following: creation of state database; creation of specialized systems for maternal and infant mortality monitoring; local language translation; integration with Geographical Information Systems; integration with Oracle. Some brief details are presented.
State Database and its web enablement: In January 2004, we were contracted to create a state level database. The district database piloted in Chittoor was modified and implemented in each district, and populated with one year data (2003-2004). The data files were exported from the Data Mart to a text file and merged into a State level database that was created on MySql and web enabled using DotNet. The database currently holds about 3.5 million records.

Maternal and Infant Mortality systems: To enable the monitoring of infant and maternal deaths, special systems were created, and also web enabled. Various reports have been provided to drill down the deaths to the level of names of the deceased. This system will be plugged in to the state database.

Local language translation: Using the HISP multilanguage functionality developed by South Africa, the application has been translated to Telegu, the local language in AP. Telugu language can be enabled using "Regional Language and setting", and all text-strings appear with a $ prefix. Each text-string was translated one by one by HISP team members (all native Telugu speakers), a complicated process given the differences in keyboard layout and number of alphabets (Telugu has 56). Reports available in Telugu can potentially help in widening the circulation of the reports (for example, to the municipal authorities who tend to be more proficient in Telugu), and to allow health workers to make more relevant interpretations.

Geographical Information Systems: A "HISP Spatial Analyst" module was developed to allow the integration of the routine data, indicators and infrastructure with village boundary maps, overlayed also with population and road maps. The application is developed in Map Object 2.0 and Maplite, and further open source tools are being identified for allowing the application to be web enabled. The use of map representations has been found especially useful for senior officials and political figures at the state level.

4. ANALYSIS

The social construction of technology perspective briefly outlined in the theoretical section helps us to analyze why the customization processes of the same software within the same application domain (primary health care) in two different countries lead to very different outcomes. While in India, the software customization has led to quite significant developments in the application (for example, creation of state database, web enabled, porting to MySql, automation of multiple reports for different stakeholders etc), in Mozambique the struggle is still on getting the data entry modules in place and populating the district database. This is despite the fact that the customization process started earlier in Mozambique, and greater funds were earmarked to the process as compared to India. We discuss four set of socio-political-technical conditions that contribute to these varying outcomes.

The health sector context: The political, social, institutional, cultural and infrastructural context surrounding the health sector is significantly different in the two countries, which have direct influence on HIS issues. For example, because of its war torn history, the Mozambique health sector has been historically donor dependent, and aid money constitutes a much larger proportion of the health budget as compared to India. This donor dependence has then contributed to the development of a multiplicity of legacy systems, a situation not seen to the same degree in India. With respect to HIS implementation, Mozambique has the advantage of smaller size of districts and fewer numbers of clinics as compared to India, implying fewer points of facilitation required. However, the relatively poorer quality of public transport access, nullifies too a large degree this advantage.

Organization of the development team: In India, the team comprised of full time staff, all of whom had formal computer science degrees, and were native to Andhra Pradesh. The team was coordinated by an anthropologist, who was especially focused on issues of relationship building with the health department, and developing a deeper understanding of the work practices of health staff. In Mozambique, the team comprised of university faculty (informatics and medical), who were responsible for both the project work and their individual PhDs, with the challenge of trying to match the two. This challenge was not easy to resolve in practice because of various reasons including logistics (scheduling of travel to Oslo), the cost of travel to and staying in the districts. For example, in Mozambique the cost of a one night in a hotel in a district may be USD 30-40 which could be the cost of a whole month stay in a rural area of Andhra Pradesh. These issues made it difficult to provide close and continuous field level support to the staff in Mozambique, while in India there were full time people supporting PHC-level implementation. While the training strategy in Mozambique was primarily province-based, in India the focus was providing on the job support to the staff in their respective clinics or cluster hubs.

The nature of the customization process: The customization process in the two countries evolved quiete differently. In Mozambique, the starting point was the DHIS software, and the attempts were made to automate the existing formats and structures into the software. The efforts were thus geared towards replicating the existing formats and structures into the computer-based system. This process of replication was based on the strategy that changes should be minimized so as to reduce the potential of user "resistance" to the new systems, and that the training efforts could then primarily focus on teaching computer skills to run the same procedures but on the computer. In this way, the efforts were towards using the capacity of the existing installed base without making radical changes. In India, the starting point was on understanding the flows of the paper based system, and the rationalization of the existing data sets. Nearly eight months were spent on conducting a situation analysis, and through this process, the data items being collected were reduced from around 1000 to 350. In India, as contrasted to Mozambique, the manual process around the HIS itself was attempted to be redefined, before the computers were introduced nearly a year after the situation analysis.

The nature of the installed base: In Mozambique, there had been multiple (mostly donor initiated) attempts to introduce various computer-based HIS such as SisProg, and also for particular health programs (Nhampossa 2004). As a result, multiple legacy systems now constitute the National HIS, which for both technical and institutional reasons are difficult to replace with new initiatives like DHIS. For example, the MoH for reasons of history and inertia still continue to favour SiSProg which we found to be extremely inadequate to meet current reporting needs. However, technically enhancing SiSProg is difficult because of the outdated platform on which it is developed, and the absence of documentation and source code. However, in India, there were no such legacy systems operating in the sub-district level of the PHC, although there was another system at the district level which was however rather standalone and not in conflict with our existing initiative. The existing legacy systems here can be seen to exist in the form of the paper formats for data collection and reporting. These legacy systems

were in most cases easy to eliminate (the staff welcomed reduction of their manual efforts spent on dealing with paper), and forms which could not be changed (for example, the CNA one), it was relatively easy (as compared to computer-based legacy systems) to adapt the computer screens to replicate these forms.

The question of language: The language translation process, as described in the Mozambique case, was a major focus of the customization efforts there for nearly the first two years of the project. There were technical issues involved (for example, the earlier mono and multi-language discussion), and also language issues related to meanings and inadequate vocabulary. In India, English was the used language for the application (as also in the paper system), and the translation to the local Telugu language was done much later in the process only after the system had been made relatively stable. Translation was done only as a "value added" feature, and not as a fundamental pre-condition to get things started as was the case in Mozambique. In the absence of needing to engage with the translation issues, the Indian project could very quickly start to develop the routine and analysis reports which were seen to be of immediate value to the health staff. In Mozambique, no similar value was at stake in the translation process for the health staff.

5. CONCLUSIONS

Our analysis, necessarily brief, identifies some of the reasons why the customization of the same software in two different contexts contributes to very different outcomes. Understanding this process of social construction helps to emphasize that debates around internationalization and localization of software needs to also consider the process of software customization itself. This process is extremely context dependent, and cannot be treated as a context independent variable that can be replicated in different settings.

Our analysis contributes directly to the theme of the conference on "Enhancing Human Resource Development through ICT". India and Mozambique have very different levels of human resources capacity, both in terms of numbers, formal education and experiences in software project management. Given these different capacity levels, the strategy for human resource development, both for the project team and for the health staff, need to be necessarily different. In Mozambique the human resource development process has to be more long term in nature, and along with computer literacy, the training has to also cover more basic principles of health information systems and public health concepts related to for example, statistics and health indicators. In India, since the computer literacy skills are relatively more prevalent, the focus needs to be more on building a social system perspective, and also on including greater public health inputs.

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Contextual issues impacting the appropriateness of ICT: Setting the stage for socio-technical research in Africa

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ABSTRACT

Information and communication technologies (ICT) can greatly contribute to information management in African organizations, like they have contributed to organizations in western countries. ICT can provide possibilities for growth in the global economy. However, using ICT with an expected impact is both social and technological an issue. We can broadly define social issues to include human, organizational, societal, economical and cultural aspects, which are still difficult to manage and consider. These aspects should be studied already when developing usable ICTs. This paper presents our plans to study how social, political, historical, and economical issues can be addressed in information systems development process in Africa.

The research project presented in this paper, INDEHELA-Context, is a continuation to the previous INDEHELA-Methods project. The main overall research question of the INDEHELA (Informatics Development for Health in Africa) program is how African healthcare facilities and healthcare management can get software applications that enable them to use ICT to provide better healthcare services for the people. This question includes the challenge to develop the required human resources as well. The research partners in this research in progress come from Nigeria, Mozambique, South Africa and Finland.

This is a research-in-progress paper, aiming at describing the initial research plans of the Finnish research group within the INDEHELA programme. The main focus is on contextual issues – the socio-economic impact, sustainability and affordability in information systems development.

INTRODUCTION AND OBJECTIVES

This research-in-progress paper is based on a four-country project on Informatics Development for Health in Africa (INDEHELA), funded by the Academy of Finland. The research is focusing on the socio-economic impact, sustainability and affordability in information systems development (ISD) in and for Africa. The overall research question is formulated as:

Is it possible and how to deal with important societal and contextual issues – socio-economic impact, sustainability, affordability – in the day-to-day information systems work by a) indigenous professionals in local software companies in a severely constrained setting, b) expatriate consultants in international IT development projects?

The countries that participate in the project are Nigeria, Mozambique, South Africa, and Finland. The empirical parts of the project are conducted in African countries mainly by the African researchers. The role of the Finnish group is mainly comparative and theoretical. The main field of practical experiments and examples is the healthcare sector. This paper focuses on the Finnish part of the project.

In Africa, like in any other continent, personal computers are widely used for word processing, and electronic mail has become an important means of communication. It would therefore be feasible and justified to use information and communication technology (ICT) to facilitate healthcare delivery and management, which is one of the high-priority sectors in any country. However, computers are of little use in healthcare without purposely built software. Previous experience has long since showed that healthcare software developed for the requirements of industrialized countries do not fit African healthcare facilities' requirements, at least without

major re-design. Healthcare facilities in Africa need purposely built software applications (Korpela et al. 2004b). However, university education of software developers in Africa focuses more on technical issues than contextual issues, which is seen as a deficiency (e.g. Soriyan 2004).

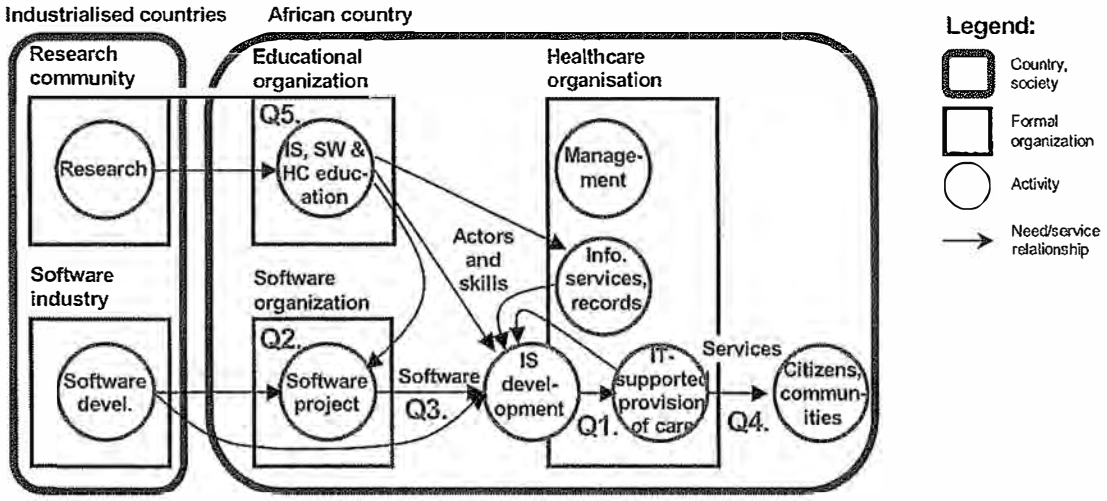


Figure 8: The main chains of activities around information systems development for healthcare, indicating the research questions (Korpela et al. 2004b).

The overall research questions behind the INDEHELA program are illustrated in *Figure 8*, which depicts the main units of analysis and some of their relations in a generic way. The research questions are the following (Korpela et al. 2004b):

Q1: How can African healthcare facilities and healthcare management get software applications that enable them to use ICT to provide better healthcare services for the people? (the main research question)
Q2: What are the potential roles of local information systems (IS) professionals in the software service chains?
Q3: What are the characteristics of appropriate software?
Q4: How to ensure that computer-based information systems in healthcare in Africa will be sustainable and affordable, and will have a positive long-term impact on healthcare services?
Q5: What kind of education of ICT professionals and healthcare professionals is needed to support these objectives?

In this paper the preliminary and introductory research plans of the Finnish site are introduced. The research here is focusing on questions Q3 about appropriate software and Q4 about sustainable and affordable information systems. The results should contribute to Q5 about human resources development. The contributions of other countries are described elsewhere (Korpela et al. 2004b), they are in brief:
- Nigerian focus: action research around MINPHIS (Made in Nigeria Primary-care and Hospital Information System), validation of IS development methods in companies (results of the INDEHELA-Methods phase)
- Mozambican focus: three types of healthcare software development (software companies, in-house IT departments and non-governmental organizations), healthcare management, education
- South-African focus: small-medium size medical practice, DHMIS (district health management information system) history, curriculum development

The paper is composed of the following parts. First, prior results of the previous phase of the project are shortly reviewed and the research approach of the current phase introduced. The next section introduces the research design for studying contextual issues. The Finnish contributions for this study are then described as the main message of this paper. Finally we conclude by summarising the objectives.

PRIOR RESULTS AND RESEARCH APPROACH

In the first phase of the program, INDEHELA-Methods in 1998-2001, empirical information about IS development in Nigerian software companies was collected in a joint Finnish-Nigerian project (*Figure 9*)

(Korpela et al. 2000a). The results showed that the software industry was technically capable but dominated by foreign packages, and there were very few companies involved in the healthcare sector (Mursu et al. 2002, Soriyan et al. 2002, Mursu 2002, Mursu et al. 2003a, 2003b, Soriyan 2004). A parallel study revealed major inadequacies in software education in Nigerian universities. The industry-wide surveys were complemented by case studies, one of which analyzed the 14 years history of the MINPHIS (Made in Nigeria Primary-care and Hospital Information System) project in the Obafemi Awolowo University (Soriyan 2004).

The other case studies covered three software companies in Lagos, which provide customized or imported software applications to local clients. Also these results strengthened the picture of technically capable companies, struggling with unstable environment, unskilled staff, clients not used to modern ICTs, and other contextual risks (Mursu 2002, Mursu et al. 2002, Mursu et al. 2003a). Furthermore, research methods and conceptual frameworks were developed, which addressed the research questions (Mursu 2002, Mursu et al. 2003b, Soriyan 2004, Korpela et al. 2000b, Soriyan et al. 2001, Korpela et al. 2001, Korpela et al. 2002, Korpela et al. 2004a).

In summary, the results from the INDEHELA-Methods phase can be described as informational (fact-finding and knowledge-creating) results as well as initial ISD-methodological results. The objective was to collect and combine an appropriate methodology for Nigerian practitioners and education in information systems development. The research project was studying something that had not been studied before, namely information systems development practices in Africa and in Nigeria. Thus the informational part collected knowledge about these practices, problems, risks and methods. The initial methodological part consists of an overall model of information systems development process in Nigeria, risk management model and sustainability analysis model (Soriyan 2004, Mursu 2002, Mursu et al. 2003b).

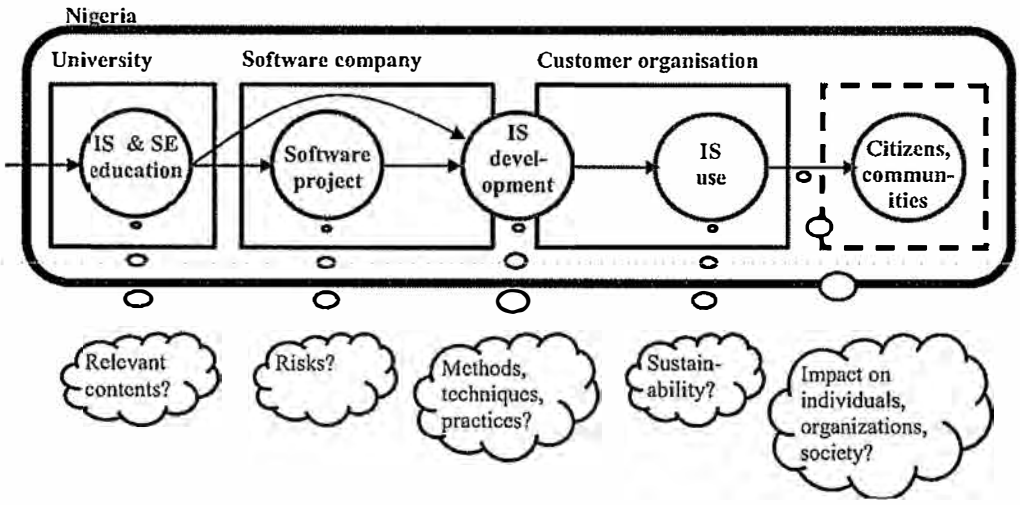


Figure 9: Research context, objects and questions in the first phase, INDEHELA-Methods in 1998-2001.

This paper deals with the second phase, INDEHELA-Context in 2004-2007, which expands the research to wider contextual issues – the socio-economic impact, sustainability and affordability in information systems development in and for Africa, with healthcare as the focus (*Figure 10*). Contextuality cannot be studied in one context only. Correspondingly, the project was extended to Mozambique and South Africa in addition to Nigeria (Korpela et al. 2004b).

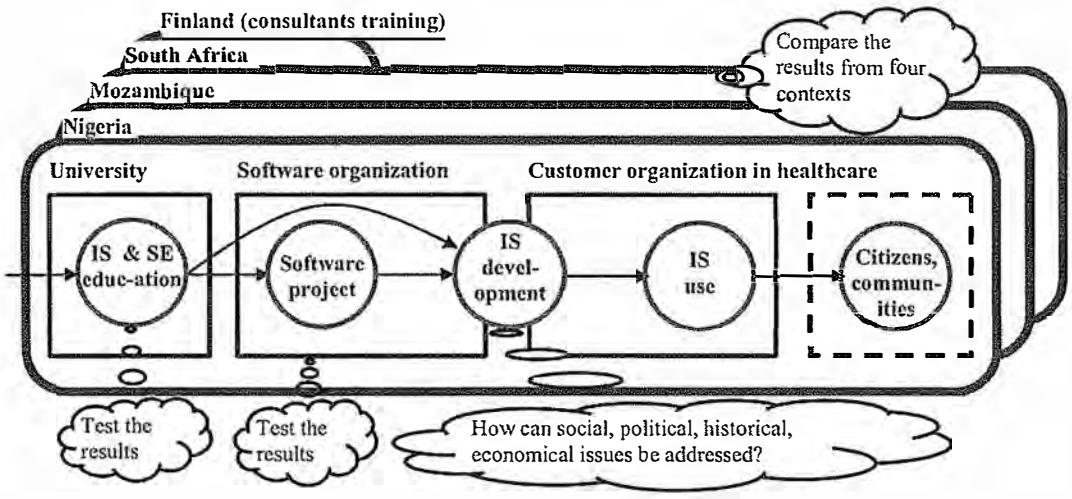


Figure 10: Research contexts, objects and questions in the second phase, INDEHELA-Context in 2004-2007 (Korpela et al. 2004b).

RESEARCH DESIGN FOR CONTEXTUAL ISSUES

Since Finland is not an African country, the main contribution of the Finnish research group is indirect, focusing on three main areas: comparative studies between contexts, the characteristics of "appropriate" software, and the role of international consultants. Furthermore, in the previous phase the Department of Computer Science and the HIS R&D Unit at the University of Kuopio had a major role in developing the research framework, Activity Analysis and Development (Korpela et al. 2000b, Korpela et al. 2001, Korpela et al. 2002, Korpela et al. 2004a), which they will continue to elaborate on during this study. Besides the indirect contribution, there are some empirical efforts that Finnish researchers are planning: to test previous results like sustainability analysis ideas, and to focus on new research on contextual issues. The empirical parts are to be conducted in collaboration with research groups in Nigeria, Mozambique and South-Africa.

While each of the African research groups are focusing on their own context, the Finnish group aims at collecting and arranging the results of the other groups for comparative analysis. The Finnish group will search for comparative material from Finland and other industrialized countries, e.g. empirical studies on the information systems development practice in healthcare. Thus the contributions will be at the comparative analysis, linking the specific empirical findings at the activity or organizational levels of analysis and the wider societal, political, cultural and historical phenomena in each country. The objective is to find integrative linkages between the phenomena and theories taking place at the levels of individuals, groups/activities, organizations/institutions and societies (Korpela et al. 2001). Such linkages will first be descriptive, explaining how these levels of analysis interacted in past events, but some constructive results may also materialize, advising practitioners about how to deal with contextual issues in day-to-day information systems development and use. Guidelines for analyzing and ensuring the sustainability of would-be information systems have already been sketched (Mursu et al. 2003b, Mursu et al. 2004). Additional comparative material are searched from Finland and other industrialized countries, as well as other developing countries from literature.

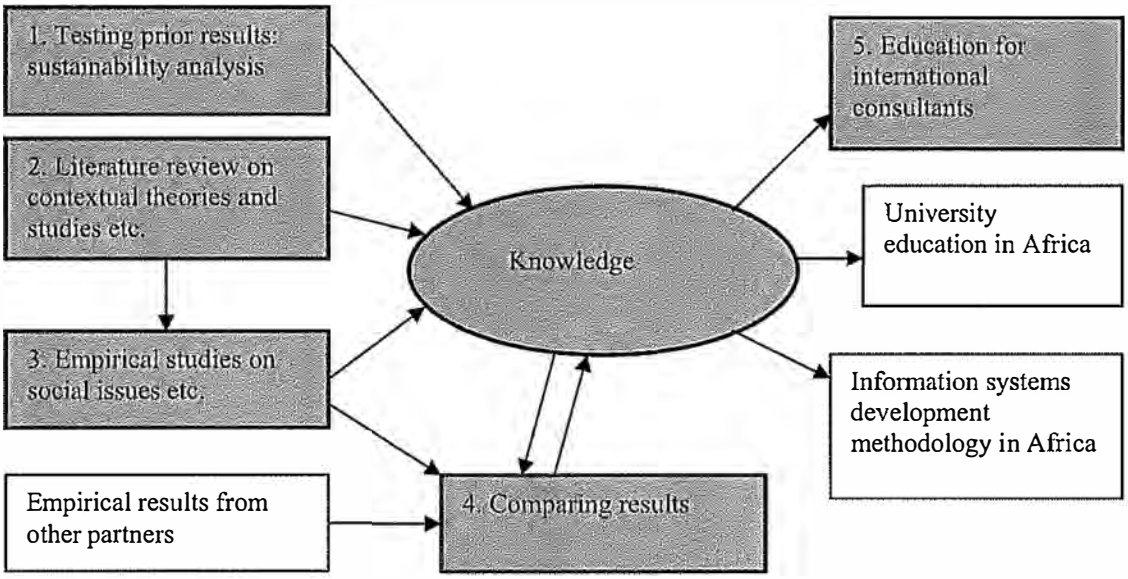


Figure 11: Research design for the Finnish parts within INDEHELA-Context in 2004-2007.

Figure 11 illustrates the research design for the contextual research questions, from the Finnish group's perspective. The grey boxes are the direct contributions of the Finnish researchers: testing the results of the previous phase; literature review on contextual theories; empirical studies on social issues; comparing the results from each other group in the light of the literature; and creating 'IT for Development' education for international consultants. The white boxes indicate indirect contributions: collaboration in empirical studies in other countries; providing methods and experiences to information systems development methodologies in Africa, from the INDEHELA-Methods phase too; and providing results and experience to ISD education in universities in Africa. In the following, boxes 1, 3 and 5 are discussed in more detail.

FINNISH CONTRIBUTIONS

In the following we describe our initial plans for testing the sustainability analysis model in practice in Nigeria, and for creating a research stage for contextual studies. A few words are also provided concerning international consultants education, in relation to human resource development also in developing countries.

Analysing sustainability

In the previous phase of the INDEHELA programme we noticed the importance of the sustainability of information systems as a major precondition for the successful use of IS. The basic value of technology comes from the improvements caused by technology for example in the organizational activities, and how these improvements are sustained and enjoyed over time. Our results support the idea of having all levels of society – human, organizational, societal, economical, and cultural – involved in the introduction of ICT, in order to have sustainable ISs. But there are few methodological tools for analyzing the sustainability of IS in organizations. Sustainability analysis should be a logical part of risk management in IS development.

We have developed an analytical tool or model for sustainability analysis (*Figure 12*), the theoretical underpinnings of which have been introduced earlier in two papers (Mursu et al. 2003b, 2004). The model would help project managers and system analysts in software projects to design and implement ISs that are sustainable. The model is based on the following theoretical backgrounds: sustainable and appropriate technology, as well as work activities and work development. The sustainability of a technology is defined to be functionally dependent on three variables: the level of demand for the technology (column 1 in *Figure 12*), the availability of local technological capacity to sustain its beneficial use (column 3), and the appropriateness of the technology (column 2) (Oyomno 1996). On the other hand, also technological development should focus on empowering local

communities to be self-reliant, in contrast to purely economic growth (Pellegrini 1980). ICT is introduced and organizational information systems created by the ISD process (column 4), and because we consider ISD to have a major impact on the organization and work activities, we consider work development to be an essential part of ISD. We have applied activity theory when analysing work activities in organizations.

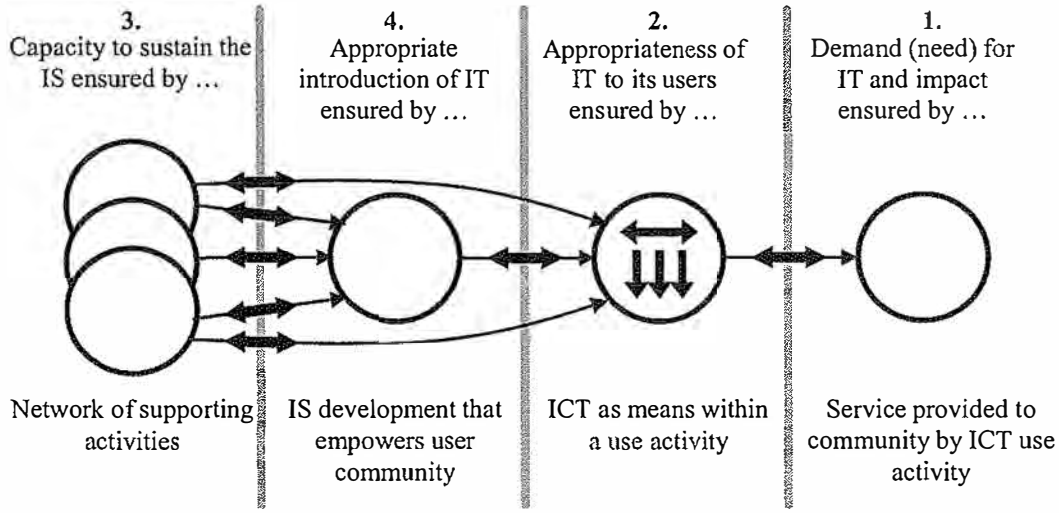


Figure 12: Model for analysing the sustainability of an organizational information system, as a network of activities (depicted by circles) around the IS use activity.

The objective is to test the ideas of the analytical tool for sustainability analysis. The model has not yet been tested in practice, so before becoming a method for ISD, it should be tested in some organization by analyzing the latter's existing information system. The model and the analysis can be approached by the following questions: what is the actual demand for this examined technology, how usable the ICT is in the use activity, what are the supporting activities for ICT use, and how well organized or managed is/was the ICT introduction or information system development process.

1. What is the demand for the technology? Define the use activity, the clients of the use activity, and the network of activities, and analyse questions like;
- To what extent are the applications or activities to which the technology is put, critical to the proper functioning of the organization?
- What is the expected productivity gain accrued to the organization as a result of using the technology?
- What is the value of the outputs from the technology to the organization, or to the activity or service?
- What is the value of the outputs from the technology to the clients (community)?

2. How usable is ICT to the use activity? Analyse questions like:
- Cost-effectiveness of technology: what is the quality of the information obtained by the new technology, and the extent to which jobs are enriched by the new technology?
- What are the human resource requirements for the new technology, and what are the needed changes in the activity or organization? How well does the new technology fit with neighboring activities?
- Suitability: is the operational simplicity, flexibility, maintainability, and robustness of the new technology suitable to the activity in question?

3. What is the sustaining capacity? Define supporting activities:
- What is the local technological capacity build-up, physical and intellectual?
- Which needed services can be obtained from inside of the organization, which from outside?
- What is the level of outside support – organizational, national, global?
- How do we institutionalize new practices? Where can we get the required training or education for employees? What about the organizational level?
- Does the new technology have an impact on the organizational culture?

4. How well managed is the introduction of technology?
- How to organize and plan an ISD project?
- What is the level of participation of users? How to organize user participation, or community participation?
- What are the software project risks? How to manage these risks?
- What are the risks for sustainable system? How to manage these risks?

In order to test the model we need to cooperate with an organization using a recently introduced information system, for instance a hospital. The suitable research method would be a case study, and the data collection methods can include interviews, observations, secondary data from documents and perhaps focus group discussions.

In the model, when we are talking about activities, use activity or supporting activities, we actually mean work: work activity as a basic unit of analysis. In order to understand work and how usable or sustainable an ICT can be for the work, we need to see the work historically. We need to analyse, how this work has been developed into what it is today, what have been the previous phases, what did cause the change process in the history, and so forth. In addition to the work history, we also need to understand the history of the organization and the society which the work activity takes place in. In that way we have a possibility to understand the contextual issues that are discussed in the following part.

Theoretical contextual studies

In order to create a basis for contextual studies, we need to conduct a proper literature review of contextual theories and previous research. Thereby we can develop our own theoretical framework for studying contextual issues, and create a research approach. However, here we want to tentatively speculate on the possible concepts and aspects that might be relevant.

'Context' refers to the conditions in which something exists or occurs. Context is that which surrounds, and gives meaning to everything. Every action, item or idea has a context, and it can vary depending on the moment.

Information systems exist in organizations in a specified context. Information system is an essential element of an organization. The organization or institution has emerged under the influence of a special context. The uppermost and largest element in context is environment. The environment includes e.g. the infrastructure, the political and economical situation, and the culture with its entire dimensions. All these lower elements are as well compositions of many more specific entities, like culture is a huge entity of education, religion, arts, politics etc. History, as well as the course of time are essential forces as means of creating a context.

Thus, context is a very wide concept. In this research the context is bounded as followed:
1. The view to the context is information system development (in developing countries)
2. The focus to the environment is organization, or an entity inside an organization.
 - organizations in Africa (Nigeria, Mozambique and South Africa), organization in Finland
3. The moment of context is to be focused on ICT implementation and use. This will be divided into more specified points in time (as the knowledge of the researcher increases).
4. The actors inside the context are the primary users of the information system, although during the implementation, or on the business-to-business level, the actors are all the producers or customers related to the context researched.

The Two Times Four Integrative Levels of Analysis. According to Korpela et al. (2001) in IS research four integrative levels of analysis are important: the individual, group/activity, organizational, and societal levels (Table 1).

This research is situated on the organizational and the societal levels, primarily in the intra-viewpoint column. Nigeria, Mozambique and South Africa (and Finland) as countries are situated on the societal level. In the intra-viewpoint level the culture and the infrastructure of the country are analysed, and their effects on the organization level. On the inter-viewpoint level the issues that concern this research may be e.g. competition and foreign investments.

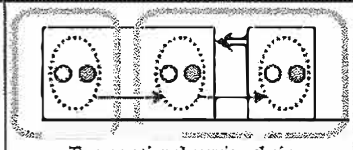
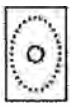
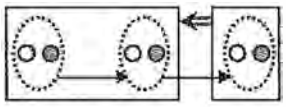
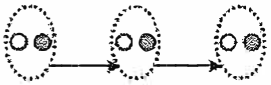
Level of analysis	Intra-viewpoint: the unit of analysis as such	Inter-viewpoint: relations or comparison between units of analysis (an example)	Theories, frameworks, names (examples)
Societal	 Country/culture	 Trans-national service chain	Sociology, political economy, cross-cultural studies, Castells, IT for Development
Organizational	 Organization	 Business between organizations	Organizational theories, economics, resource-based theory, MIS, BPR
Group/activity	 Activity	 Service chain between activities	Work research, activity theory, actor network theory, Engeström, CSCW
Individual	 Person	 Men/women, doctors/nurses, etc.	Social psychology, gender studies, behaviorism, Kolb, HCI

Table 1: The 2 x 4 integrative levels of analysis.

The main focus of the research is on organizational level, information systems in the organizations. At the intra-viewpoint level the object is everyday work and the functioning of the system. Then, if possible, the study will be broadened into the inter-viewpoint level, e.g. into the implementation and education of new system/software.

The research problem is to find

1. what are the essential factors that should be known about context
2. context-originated differences and similarities between
   a) various information systems in developing countries
   b) ISs in developing countries and industrialised countries

The research objects are situated in different states and represent various kinds of organizations. The differences concerning the context of the research object may be e.g. cultural, geographical, technical, political, and economical.

The research questions are:

1. How can the context-originated phenomena be detected
- What mediates and where

2. What are the context-originated phenomena

3. How do these phenomena influence to the functioning
- of the information system in everyday work
- of the co-operation between the organizations during the information system development, considering the varying roles (and environments) of a customer and producer (e.g. means of communication)

4. How do these phenomena differ between various systems and countries

Besides literature review and theoretical consideration this part of the study needs some empirical approaches as well. Most of the empirical material should come from the studies by other researchers within and beyond the INDEHELA-Context project. The critical issue with this empirical secondary data is, whether the context and its

change is described in research documents to such an extent that contextual factors can be analysed. To get deeper insight and develop the conceptual framework of contextual analysis, the Finnish group needs to conduct some empirical research by itself too. The possible research methods for empirical studies could be case study, including interviews, observations, focus group discussions; quite the same methods than in the sustainability analysis study. The first step to create the collaboration with possible case organizations took place during a visit to Nigeria in November 2004.

International consultants education

Expatriate experts have a significant role in international development projects and transnational companies that operate in the field of ICT applications in healthcare in Africa. It is crucial that such ICT consultants would actively search for genuine collaboration with local professionals and take into account the social issues of impact, sustainability and affordability in addition to technical issues.

The Finnish research group is in charge of producing modules and teaching material on 'IT for Development' to a Master's programme in International Development in Finland, targeted to international development consultants and transnational companies' personnel. Some parts of the course contents and teaching material can be common with the African partner universities as well as with the Department of Informatics at the University of Oslo, which has collaborative relations with the Mozambican and South African INDEHELA sites. In Finland, the INDEHELA group in the University of Kuopio is searching for collaboration with other research groups in the field of 'IT for Development' in other universities. (Korpela et al. 2004b)

The course on 'IT for Development' should include topics like what is information society and what it means in developing countries; what is the desirable role of ICT for development; how to define appropriate technology; what is information systems development and software industry in developing countries; what is global software industry from the viewpoint of developing countries; and what software technology transfer means and what is its impact on developing countries.

Enhancing human resource development

We connect our research objectives and contributions quite strongly to the theme of enhancing human resource development in developing countries. The results of the previous phase indicated the gap between practice needs and university education in many areas, including technological and business environment, and the lack of local contextual considerations. We believe that our research could have the following implications for human resource development:

- **University education in Africa.** The university education can be influenced by two ways; by providing tools for basic software development process and by providing new ideological methods and ideas on information systems and how ICT can be used for development. Within this project we aim to produce modules and teaching materials on 'IT for development', as was explained above. We can provide and use this same material in curriculum development in our counterpart African countries. In that way we can facilitate the future IT experts with knowledge and skills at information society - locally and globally - and at the changes taking place in technological and also business environment of organizations.
- **Work practices and development methods in organizations.** By providing ISD methods for contextual and organizational analysis, sustainability analysis, and environmental risk management to organizations, both software organizations and user organizations, we can facilitate people working within information systems development process with skills to manage changes in organizations in this information age. In that way organizations are more capable of utilizing modern ICTs effectively in their environment, and providing better services to citizens and communities.

CONCLUSION

The development and acquisition of appropriate software for African organizations, like healthcare organizations, is a deeply socio-technical issue. INDEHELA-Context is a major research undertaking in African healthcare informatics, aiming at highly practical as well as theoretical results. The purpose is to create a collaborative network of research groups from Nigeria, South Africa, Mozambique and Finland, at the moment.

In this paper we presented the research objectives and tentative research design of the Finnish group of the INDEHELA research programme. The purpose of the paper is to set research questions and formulate research strategies to answer these questions. In 1998 in WG9.4 Bangkok conference we presented our plans of the

previous phase of the project by saying that academic research and education in Africa is overwhelmingly oriented in pure Computer Science at the expense of Information Systems Science and applied approaches (see Korpela et al. 2000a). The objective was to create an information systems development (ISD) methodology suitable for African practitioners. The results of that previous phase are now partly ready to be tested within the present project, but we also noticed the lack of contextual understanding within the ISD process. Thus we started the INDEHELA-Context project in order to study the socio-economic impact, sustainability and affordability in information systems development in and for Africa in more detail.

The INDEHELA-Context project's results aim at influencing African education and work practices by providing training modules and development tools based more on Information Systems Science than pure Computer Science. Thus we strongly believe that our research can provide valuable implications also for human resource development.

ACKNOWLEDGMENTS

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Using ICT to Develop Botswana: An Analysis of Government Proposals and Recommendations for Action

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ABSTRACT
The paper briefly describes various initiatives undertaken or to be undertaken by the Government of Botswana, and which may be looked upon as "Information Society" initiatives. These initiatives are critically analysed and conclusions are drawn from our analysis. Based on the conclusions we make certain recommendations regarding the implementation of the initiatives. We also conclude that apart frol the Information Society initiatives, the Government should have in place a National Human Resource Development Concord. Such a Concord is seen to be indispensable as a foundation for the successful implementation of the initiatives, when adapted as recommended.

1. Introduction

This paper looks at various initiatives undertaken or about to be undertaken by the Government of Botswana, and which may be regarded as "Information Society Initiatives". They include Vision 2016, The National Development Plan 9 (NDP9), the National Communication and Technology (NCT) policy, and the National ICT Master Plan. The Government, Private Sector and other Stakeholders share a belief that ICT is a foundation medium for the equitable distribution of opportunity and knowledge within societies and communities and a key determinant of the competitive advantage of Nations. This belief has resulted in a shared vision that expect the dividends of ICT to be taken to every village, to every citizen, to every business and also transform the way Government works. Botswana, it is envisioned, will use ICT to develop the nation's economy, alleviate poverty, and improve the quality of life and the opportunities for all people of the nation (Sebetela, 2003). While focusing specifically on Botswana, our aim with this paper is also to gain an understanding of the way in which National ICT Policies in developing countries are formed, and the pitfalls that could derail such initiatives.

The paper is structured as follows. In the next section we provide a brief background about Botswana. This is followed by brief descriptions of Vision 2016, NDP9, the NCT Policy, and the National ICT Master Plan. To provide a background for our analysis, we briefly revisit the concept of "development", or, more specifically, "sustainable socio-economic development". We then analyse the abovementioned initiatives and draw conclusions from this analysis which lead to certain recommendations regarding the way forward for Botswana. Lastly we indicate some planned future research.

2. Background about Botswana

The population currently stands at about 1.7 million, of which the majority is of Tswana origin. The national language is Setswana, but English is an official language that is widely spoken in business and government. Botswana's estimated population growth rate in the period from 1999-2001 was down to 2.3% from 3.5% in the period between the 1981 and 1991 census. Even before HIV/AIDS, Botswana was sparsely populated, with only 2.8 people per square kilometer.

Botswana has a vibrant and liberalized economy that is closely tied to that of South Africa. The Gross domestic product (GDP) for Botswana in 2000 was USD 6 billion. GDP per capital is USD 3,560, making it the second highest in sub-Saharan Africa following South Africa. Botswana's economy is dominated by the diamond-mining industry, which contributed 33% of GDP in 1999/2000. The tourism industry accounts for just over 10% of GDP, as do financial and business services. Agriculture, which employs more than 25% of the population, contributes only 3% to the nation's GDP, due to severe droughts and poor soil conditions. Unemployment was officially reported at 15.6% in 2000, but other estimates peg unemployment at 30%, with 33.3% of the population living below the poverty line.

Botswana ranks 114 out of 162 countries on the United Nations Development Programme's Human Development Index (HDI). While its HDI ranking is low on a global basis, it has the sixth highest HDI in sub-Saharan Africa. The country's literacy rate for those 15 and above was 76.4 in 1999. The country spends 8.6% of its GNP on education, 2.5% of its GDP on health and 3.4% of its GDP on military expenditure. Botswana ranks 103 on the UNDP gender-related development index.

3. Vision 2016

The work of defining Vision 2016 began in August 1996 with a nine person Presidential Task Group. They produced a booklet entitled "A Framework for a Long Term Vision for Botswana". Vision 2016 is a national manifesto for the people of Botswana and reflebts the views of many different parts of the society. It is a statement of long term goals that identifies the challenges implied by those goals, and proposes a set of strategies that will meet them.

The objectives of Botswana's Vision 2016 are:

- Halving poverty from 47% (1994) to 23% by 2007
- Maintaining 8% per annum GDP growth until 2016
- Increasing per capita income from $3300 in 1997 to $8500 in 2016
- Maintaining a budgetary allocation of 35% to the social sector while improving "pro-poor" actions
- Containing and reversing the spread of HIV and AIDS with a view to achieving an AIDS-free generation in 2016
- Mainstreaming gender into the development process and
- Promoting a Just, Participatory and Compassionate Society.

4. The national development plan 9

The NDP9 preparation process started in June 2001, under the guidance of a multi-sectoral Reference Group, which comprised Government officials from the Ministry of Finance and Development, Office of the President, the Ministry of Local Government, representatives of the private sector, trade unions, non-governmental organisations, the Vision 2016 Council, and the Bank of Botswana, among others.

The theme of NDP9 is **'Towards Realisation of Vision 2016: Sustainable and Diversified Development through Competitiveness in Global Markets'**. The choice of this theme was guided by the fact that NDP9 provides the first opportunity for the various Ministries and other stakeholders to integrate Vision 2016 goals and objectives into the national development planning process. The theme also recognises the importance of competitiveness in global markets, which is seen as an essential prerequisite for the sustained high rate of economic growth called for by the Vision.

5. Formation of National Information Communication and Technology Policy in Botswana

5.1 Background

The Government of Botswana aims at creating an enabling environment that will assist the country to establish itself as a Regional ICT Hub for ICT infrastructure, trade and development. This Hub will assist in providing opportunities for the development of the local ICT firms, efficient delivery of services through the use of ICTs by Government, parastatals and the private sector and diversification of the economy from a mineral-based economy to a more sustainable information-based economy. The Government has therefore called for appropriate policies and strategies for the development of the ICT sector to realise the country's aspirations for becoming a regional leader in the exploitation and utilisation of ICT.

5.2 National Communication and technology policy

The National ICT Policy will detail the various programs and projects that will need to be undertaken to achieve Botswana's National ICT Vision. For this phase, various Task Forces will develop the objectives and strategies for each area of the National ICT Policy. The Task Forces will be moved through a series of facilitated sessions, examining and discussing international best practices in ICT, and developing innovative ICT solutions that address the specific goals and objectives of the national ICT vision.

The policy will specify targets for different aspects, such as e-Governance, Access to Communities, Education, Health, Production Sector, Commerce and for ICT services as catalyst for generating new industries and employment.

5.3 National ICT master plan

The National ICT Master Plan is a component that details the process of implementation of the vision and the outcomes described in the National ICT Policy. The Master Plan will facilitate a mechanism to ensure that responsible entities deliver on specific objectives detailed in the policy. It will develop the detailed project plans for each of the major ICT program and projects – focusing on those initiatives that will be implemented earlier in Botswana's Connectivity Agenda.

The above provides a brief overview of the various Botswana initiatives aimed at establishing the country as a knowledge economy, aimed at reaping the benefits of ICT empowerment and competitively playing a part in the global ecnnomy. Before we turn to an analysis of these initiatives, we first briefly discuss the concepts of development and sustainable socio-economic development.

6. Development and sustainable socio-economic development

Within the scope of this paper it is impossible comprehensively to discuss these topics that have been, in one form or another, on the agenda of the nations of the world since the Second World War, and the overview provided below will of necessity be cursory and incomplete. We first discuss the evolution of development thinking over the last six decades – i.e., since development was "invented", as Escobar (1995, p.24) puts it, and then set out our views on development and specifically, on sustainable socio-economic development. This is necessary since our analysis in section 7 is based on subjective judgements informed by a particular view about development, and the reader should at least know "where we come from".

6.1 The Evolution of Development Thinking

Madon (2000) remarks that "modernisation was perhaps the earliest theoretical approach to development, which was intimately linked to decolonisation through the idea of nations gaining political independence to pursue national economic development. Development was perceived as a universal process consisting of a number of stages similar to those that the countries of western Europe and America had experienced." Escobar (*op. cit.* p.26) notes that "a type of development was promoted which conformed to the ideas and expectations of the affluent West, to what the Western countries judged to be a normal course of evolution and progress." He continues (p.39): "Rich countries ... were believed to have the financial and technological capacity to secure progress the world over. A look at their own past instilled in them the firm conviction that this was not only possible – let alone desirable – but perhaps inevitable. Sooner or later the poor countries would become rich, and the underdeveloped world would be developed. A new type of economic knowledge and an enriched experience with the design and management of social systems made this goal look even more plausible. Now it was a matter of an appropriate strategy to do it, of setting in motion the right forces to ensure progress and world happiness."

These basic premises of the nature of development and the discourse of development were formulated, as Escobar (*op. cit*) points out, in the 1940s and 1950s. "The organizing premise was the belief in the role of modernization as the only force capable of destroying archaic superstitions and relations, at whatever social, cultural, and political cost." (*ibid.*). Foucoult (1972), as quoted in Thompson (2003), defined discourse as "the interplay of the rules that make possible the appearance of objects during a given period of time". Escobar (*op. cit.*, p.39) describes discourse as the process through which social reality comes into being. He provides an incisive analysis of the way in which development became the result of the establishment of a set of relations between, firstly, the process of capital formation, and the various factors associated with it: technology, population and resources, monetary and fiscal policies, industrialization and agricultural development, commerce and trade; secondly, institutions such as the World Bank and the International Monetary Fund, and most of the United Nations technical agencies; and, thirdly, practices. Finally, the systematization of these relations to form a whole "constituted the way in which it was able to form systematically the objects of which it spoke, to group them and arrange them in certain ways, and to give them a unity of their own."

"By 1955", Escobar points out, "a discourse had emerged which was characterized not by a unified object but by the formation of a vast number of objects and strategies; not by new knowledge but by the systematic inclusion of new objects under its domain. The most important exclusion, however, was and continues to be what development was supposed to be all about: people. Development was – and continues to be for the most part – a top-down, ethnocentric, and technocratic approach, which treated people and cultures as abstract concepts,

statistical figures to be moved up and down in the charts of 'progress'. Development was conceived not as a cultural process (culture was a residual variable, to disappear with the advance of modernization) but instead as a system of more or less universally applicable technical interventions intended to deliver some 'badly needed' goods to a 'target' population." (*op. cit.* p.44)

Madon (2000) discusses two contemporary responses to the development discourse described above. "The first response is that of the globalists who speak a similar language to the modernists arguing in favour of a stages of growth model of development, and who advocate a thoroughly global marketplace to expand trade and spread wealth." She points out that in this response, information and knowledge are projected as major forces to shape economies and societies, and that consequently, "telecommunications and global networks have become important issues for discussion amongst government policy-makers and international agencies." The second response, according to Madon, is that of the localists or neo-populists. Neo-populist thinking, Madon says, "is forcefully articulated by non-government organisations and others giving much importance to the views, desires and ambitions of those about to be developed. Such views offer an alternative development strategy ... based on the notion that developing countries have their own trajectory of development which does not necessarily follow the same pattern as experienced by the advanced, industrialised countries. The neo-populists argue for the retention of traditional peasant agricultural systems and small-scale enterprises, for direct policies aimed at reducing poverty among target groups of the population, and for local sustainable development projects."

6.2 Human Scale Development

Our approach to development is based on the work of Todaro (1991) and Max-Neef, Elizalde and Hopenhayn (1991). Todaro pointed out that "Development must ... be conceived of as a multidimensional process involving major changes in social structures, popular attitudes, and national institutions, as well as the acceleration of economic growth, the reduction of inequality, and the eradication of absolute poverty. Development, in its essence, must represent the whole gamut of change by which an entire social system, tuned to the diverse basic needs and desires of individuals and social groups within that system, moves away from a condition of life widely perceived as unsatisfactory and toward a situation or condition of life regarded as materially and spiritually "'better' "(*op. cit.* p. 88).

Max-Neef *et al.* (1991) argued against the policies of developmentalism and monetarist neo-liberalism and proposed an approach intended to create conditions for a new praxis based on what they call Human Scale Development. Such development, they explained, "is focused and based on the satisfaction of fundamental human needs, on the generation of growing levels of self-reliance, and on the construction of organic articulations of people with nature and technology, of global processes with local activity, of the personal with the social, of planning with autonomy, and of civil society with the state." (p. 12) "Articulation" here refers to the construction of coherent and consistent relations of balanced interdependence among given elements.

Max-Neef *et al.* see human needs, self-reliance, and organic articulations as the pillars which support Human Scale Development. These pillars, they pointed out, "must be sustained on a solid foundation which is the creation of those conditions where people are the protagonists of their future. If people are to be the main actors in Human Scale Development both the diversity as well as the autonomy of the spaces in which they act must be respected. Attaining the transformation of an object-person into a subject-person in the process of development is, among other things, a problem of scale. There is no possibility for the active participation of people in gigantic systems which are hierarchically organized and where decisions flow from the top down to the bottom." (p. 13)

They also note that "... fundamental human needs cannot, by definition, be structured from the top downwards. It cannot be imposed either by law or by decree. It can only emanate directly from the actions, expectations and creative and critical awareness of the protagonists themselves. Instead of being the traditional objects of development, people must take the leading role in development." (p. 39)

Dependency relations, however, continuously hamper the development process. Such dependencies flow from the top downwards: from the international level to the national level; from the national level to the regional level, and through to the local level; from the social domain to the individual domain. Max-Neef *et al.* advocate self-reliance at all levels. They understand self-reliance "in terms of a horizontal interdependence and, in no way, as an isolationist tendency on the part of nations, regions, local communities or cultures." (p. 49) Relationships of self-reliance have greater synergic and multiplying effects when they flow from the bottom upwards. Local self-reliance thus stimulates regional self-reliance, which, in turn, fosters national self-reliance.

Self-reliance is not achieved simply by social and economic interaction in small physical spaces. "If self-reliant processes at the global and local levels do not complement each other, the most likely consequence will be the

co-opting of the micro by the macro. Complementary relationships between the macro and the micro, and among the various micro-spaces, may facilitate the mutual empowering of processes of socio-cultural identity, political autonomy, and economic self-reliance." (p. 51)

In this notion of self-reliant human scale development a satisfactory way to formalize sustainable development has been put forward by Roode (2002): *Sustainable development is achieved through self-reliant human scale development which flows from the individual level to the local, regional and national levels, and which is horizontally interdependent and vertically complementary.*

Viewed from an Actor-Network Theory (ANT) (see, e.g., Walsham 1997) perspective, the approach to sustainable development through ICT interventions would entail the institutionalization of an ICT intervention in a grass-roots community by establishing a stable network of aligned interests. Since self-reliance does not, as noted above, imply "isolationist tendencies" on the part of the local community, a further stable network has to be formed between the different communities through aligning their different interests by accepting their mutual interdependence. In the vertical dimension, communities need support from first, the local (municipal) level, and through that, from the regional, the national and even the international level. In ANT terms, this implies that further stable networks have to develop around aligned *interests* between these different levels. This alignment, Monteiro (2000) noted (albeit in a different context), "... is not the result of any top-down plan or decision. It is the achievement of a process of bottom-up mobilization of heterogeneous 'things'" But what are these *interests*? At the local (community) level we may assume an interest of sustainable socio-economic development through the development of the people of the community. It is the purpose of the next section to analyse available evidence to determine what these interests are at the higher (governmental) levels.

7. Analysis of government INTERESTS In development through ict

In this section speeches of Botswana Government officials pertaining to the documents described in sections 3 – 5 are analysed. We use Critical Discourse Analysis (Fairclough, 1989, 2002), following the adaptation of Thompson (2002), to conduct the analysis. Thompson points out that development, "as a set of relatinns which objectifies and structures marginality and thus arguably reproduces networks of power, ... is ... a particularly fitting subject for discourse analysis." "Discourse", Escobar (*op. cit.,* p.216) reminds us, "is not the expression of thought; it is a practice, with conditions, rules, and historical transformations. We implicitly assume that the Government officials, whose speaches we analyse, act (unwittingly) within the rules of the development discourse as discussed in section 6, adopting a globalist approach to development.

Thompson (*op. cit.*, and citing Fairclough.) explains his use of Fairclough's critical discourse analysis thus: "The methodology adapted ... locates social structures within a dialectical relationship with social activities. Politically, therefore (addressing the *critical* part of the method), connections between the use of language and the exercise of power are often not clear to people, yet appear on closer examination to be vitally important to the workings of power, while methodologically (addressing the *discourse analysis* part of the method), texts constitute a major source of evidence for grounding claims about social structures, relations, and processes."

The first speech that has been selected for analysis is the presentation speech on the Draft National Development Plan 9 for 2003/04 – 2008/09 delivered by the Hon B Gaolathe, Minister of Finance and Development Planning to the National Assembly of Botswana on 21 November 2002. The second speech is the Budget speech, again by Minister Gaolathe, delivered to the National Assembly on 3 February 2003.

7.1 Analysis of selected speeches

When analysing a section of text using CDA, generic and specific speech genres and discursive types are acknowledged. It is the usage and "mixing of (often contradictory) speech genres and discursive types that provide units of discursive practice, and hence discourse, with its unique power" (Thompson, *op. cit.*).

Given that the (sections of) speeches to be analysed in this paper is of a similar nature to that analysed by Thompson, similar speech genres and discursive types were identified from the text. However, since both speeches analysed were delivered in the National Assembly, some genres and discursive types observed by Thompson are absent here. The Minister speak from a position of authority and does not have to humour his audience or persuade them. To a large extent, he can simply tell them.

The speech genres and discursive types identified are shown in Table 1 below:

Speech Genre (SG)	Discursive Type (DT)
1 Confidence	1 Technocracy
2 Factual information	2 Legitimacy
	3 Neutrality
	4 Corporatism
	5 Tech(nological) optimism
	6 Pragmatism

Table 1: Speech Genres and Discursive Types Identified in this Analysis (adapted from Thompson (2002))

There is a subjective judgement in identifying these speech genres and discursive types and applying them to specific references (sections of text). In the present case this subjective interpretation is anchored in our view of development – specifically, of sustainable socio-economic development.

7.2 Analysis of First Speech

The draft National Development Plan 9 (NDP9) for the period 2003/04 – 2008/09 was presented on 22 November 2002 in the National Assembly by the Minister of Finance and Development Planning. The Minister pointed out that National Development Plan 8 came to an end on 31 March 2003, and that NDP9 was for the next six years. He stated, " ... successive National Development Plans have aimed at guiding the development of Botswana's economy and drawing up programmes of public expenditure on recurrent and development projects, based on projected revenue resources of Government, including expected inflows of external assistance in the form of grants and concessional loans. Botswana and the world have undergone tremendous changes over the three and a half decades since Independence, but our basic approach to national development planning, drawn up in the context of the national principles of *democracy, development, self-reliance, and unity*, h's remained largely intact. This is, as it should be, since these principles are as relevant today as they have always been in the past. The only major change effected, pursuant to *Vision 2016*, has been the adoption of an additional principle of '*Botho*', which is engrained in Botswana culture, and refers to a state of being human, courteous and highly disciplined."

Table 2: Analysis of First Speech

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
	We believe that successful implementation of NDP 9 policies and programmes will prepare the nation for accelerated progress towards achieving these goals of Vision 2016.	Establishment of Government's position and point of departure.	Opening with the credo of the Government: **SG1 (confidence)** Cause and effect relationships: **DT5 (optimism)**	Replication of Government's subjugation of policy as an instrument of developmentalism
	... the theme of NDP 9 is **'Towards Realisation of Vision 2016: Sustainable and Diversified Development through Competitiveness in Global Markets'**. The choice of this theme was guided by the fact that NDP 9 provides the first opportunity for the various Ministries and other stakeholders to integrate Vision 2016 goals and objectives into the national development planning	The Government's position is clarified: sustainable and diversified development would be a result of first achieving competitiveness in global markets, following a yop-down process	**SG2 (factual information) DT2 (legitimacy)**	Legitimizes the focus on competitiveness in global markets as the starting point for the development of Botswana.

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
	process. The theme also recognises the importance of competitiveness in global markets			
	… by achieving sustainable development through economic diversification, NDP 9 aims at building the pillars of Vision 2016, namely, *an educated and informed nation; a prosperous, productive and innovative nation; a compassionate, just and caring nation; a safe and secure nation; an open, democratic and accountable nation; a moral and tolerant nation; and a united and proud nation*. Given the small size of the Botswana market, global competitiveness and trade remain important for achieving sustainable and diversified development.	The main components of Vision 2016 are held up as the ultimate good that would be achieved. The process to get there involves economic diversification, which will also ensure sustainable development.	Repeating the components (pillars) of Vision 2016: **SG2 (factual information)** Importance of global competitiveness and trade: **DT5 (technological optimism)**	Reiteration of a deterministic belief that sustainable development and the pillars of Vision 2016 will be natural byproducts of economic diversification. The latter is elevated to a *sine qua non* level and legitimized as the starting point for the development process.
	Another prerequisite for keeping pace with, and benefiting from, ongoing globalisation, is improving efficiency in the utilisation of domestic resources.	Globalization is simply a moving target that has to be reached. It is a given that does not have to be analysed or dissected.	Efficiency is another prerequisite: **SG1 (confidence)** Benefits flow from keeping pace with globalization: **DT1 (technocracy)**	Replication of the Government's dominant role as expert and interpreter of course to follow.
	The overall strategy for development was formulated on the basis of the critical issues identified during the Mid-Term Review of NDP 8. These issues remain relevant for the future, and still need to be addressed during NDP 9. The policy thrust of NDP 9, therefore, includes ***economic diversification, employment creation and poverty alleviation; maintaining macroeconomic stability; financial discipline; public sector reforms; environmental protection; rural development; human resource development, including the fight against HIV/AIDS; science and technology development; and disaster management.*** These policy strategies are crucial in achieving a sustainable and diversified development through competitiveness in global markets.	The immense range of issues that have to addressed in NDP 9 is seen as "issues that remain relevant for the future", and addressing them, will be important in achieving sustainable development because it will increase Botswana's competitiveness in global markets.	Describes the various thrusts in NDP9 in more detail: **SG2 (factual information) DT1 (technocracy);** The issues identified during the review of NDP 8 remain the issues for NDP 9: **DT6 (pragmatism)**	Legitimization of issues that will be addressed in NDP 9 and course that will be followed. Reiteration of sure knowledge that policy strategies will lead to sustainable development.

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
	... the primary role of Government in the diversification process will be to provide an environment conducive for private sector initiatives and innovations to take effect.	Elevates the role of the Government to one of neutrality as facilitator.	**SG2 (factual infor-mation).** Neutrali-zation of the role that Government will play in the diversification process: **DT3 (neutrality) DT5 (tech optimism)**	Attempted move away from that of prescriber of course to follow to that of paving the way that will be determined by others.
	The private sector will need to enhance its ability to exploit existing market opportunities through increased productivity and adoption of more efficient information systems, among others.	Dictates to the private sector what its role will be.	Co-opting a macro-marketing role, as well as an adjudicator role vis-à-vis the efficiency of information systems: **DT4 (corporatism)**	Resuming a macro-stance on what needs to be done to set matters right; legitimized from a position of authority on matters concerning them
	Policies and programmes will continue to be refined to support small and micro enterprises. Information on locally available supplies will be packaged to enable large corporations and firms to procure their requirements locally. Exploitation of linkages between various sectors of the economy will also be pursued.	Spells out a plan of actions to be under-taken which is quite in contrast to that of facilitator mentioned above. It is not clear how Government could undertake these actions.	Unproblematic view of how policies and programmes will be continuously refined: **SG2 (factual infor-mation);** Assuming a supply-chain manage-ment role for Govern-ment: **DT4 (corporatism)**	Resuming the role of prescriber of what needs to be done; creates the illusion that these actions could be undertaken from the top-down.
	... during NDP 9, Local Authorities will endeavour to become customer-focused and centres of excellence in social service delivery, development co-ordination, community mobilisation and capacity building. To assist the achievement of this objective effectively and efficiently, Government has embarked on comprehensive local authority reforms ...	Describes a utopian world where local authorities have been transformed into model entities and assumes that this could be achieved through comprehensive (administrative) reforms	Mentions the programme of reforms of local authorities: **SG2 (factual information);** assumes that characteristics of the corporate world could be transplanted to local authorities: **DT4 (corporatism);** assumes that Government's assistance through the programme of reforms will effect the transformation of local authorities: **DT6 (pragmatism)**	Replication of assumptions about revolutionary change in local authorities that would result from administrative reforms initiated by Government. Assumption that local authorities would embrace this dramatic change process, and would moreover do so efficiently and effectively.

7.3 Analysis of Second Speech

The National Budget for 2003/04 was presented to the National Assembly by the Minister of Finance and Development Planning on 3 February 2003. The Minister pointed out that it was the first budget of the National Development Plan 9, after it had been approved in December 2002.

Table3: Analysis of Second Speech

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
	… the theme of this Budget Speech is ***"Improving Botswana's Competitiveness in Global Markets"***. This theme is a component of the theme for NDP 9, and re-cognises the fact that Botswana's economy is small and open, with little influence on the process of globalisation, which has been taking place through continuous growth in international trade and investment flows, as well as through advances in information technology. The globalisation process makes it imperative for Botswana to position itself for competing effectively in global markets by adjusting its economic structure and institutional framework to take advantage of opportunities offered by globalisation. **Success in this regard can be achieved through vigorous implementation of appropriate policies, strategies and programmes**, such as provision of requisite infrastructure, maintaining a conducive macroeconomic policy regime for private sector initiatives, and increasing labour productivity through human resource development …	Presents Botswana as standing currently outside the global village; entrance to the global community is presented as merely a matter of taking care of certain deficiencies in the economic structure.	Acknowledging that Botswana has to follow global trends: **SG2 (factual information)**; Human resource development is a means to an end: **DT1 (technocracy)**; Belief that the implementation of policies and programmes will result in successful exploitation of the benefits of globalisation: **DT5 (technological optimism)**	Reiteration of top-down approach that will produce as a byproduct, human development in Botswana. Elision of contextual differences between Botswana and developed countries by assuming that the adjustment of technical deficiencies will allow Botswana to become competitive in the global market
	… the Ministry of Communications, Science and Technology was established in September 2002 with the responsibility to enhance research, science and technology; to step up the national capacity for information and communications technology; and to improve the quality of and the access to mass media services. These areas need to be developed urgently so that Botswana's competitiveness in global markets can be improved. …the core infrastructure for the information society is the telecommunications network, which will need to be modernised to handle advanced technologies, which involve systems that can handle voice, data and video on a single network.	The "national capacity for information and communications technology" can be increased through technological means, being the responsibility of the department of Communications, Science and Technology.	Information about the discharge of responsibilities to remove deficiencies: SG2 **(factual information)**; Focus on the core infrastructure of the information society: **DT1 (technocracy)** The information society will be follow if the core infrastructure is in place: **DT5 (technological optimism)**	Reiteration of a focus on the technological deficiencies alone, and reassurance that the Government has taken the necessary steps to correct the situation.
	The rural telecommunications project, which started during NDP 8, is ongoing to provide telecommunications services to 147 villages at an estimated cost of about	Reinforcing the Government's attention to all sectors of	**SG2 (factual information)** Villages and people need to be	Inevitability that people who are not "connected" must be provided access to ICT as an end in itself.

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
	P125 million. It is expected that this will result in about 120 000 people being connected, starting from March 2003.	society.	"connected": **DT 1 (technocracy) DT5 (technological optimism)**	Again, elision of the assumption that the "connection" of people in rural villages will imply the development of those people
	Improvement in productivity and enhanced production techniques are a pre-requisite for improvement in competitiveness. Government will, therefore, accelerate the implementation of the Science and Technology Policy. As part of this effort, Government is in the process of developing a national research, science and technology plan to guide the implementation of the Science and Technology Policy to make Botswana a knowledge-based society and a major participant in the competitive world, following the establishment of the National Commission for Science and Technology in 2002. In addition, an information and communications technology policy and a national information and communications plan will be developed. Successful implementation of these policies, **coupled with human resource development**, should go a long way in assisting the economy to improve its competitiveness in the global village.	Describe the Government's approach to "make Botswana a knowledge-based society and a major participant in the competitive world" through the implementation of various policies.	**SG 1 (confidence) SG2 (factual information)** Society can be "made" different through policies: **DT1 (technocracy)** "Successful implementation of these policies ... should go a long way ...": **DT5 (technological optimism).**	Reinforcement of the view that Government can transform society form the top down; lip service is paid to human resource development as an "also required" component of the various mechanisms necessary to transform society. The goal remains competitiveness in the global village, not human development.
	... in order for Botswana to be competitive in global markets, the country has to develop good quality infrastructure to support industrial and commercial development, especially in rural areas where about half of the people reside. In this regard, Local Authorities continue to develop physical and social infrastructure in the whole country, which is one of the ingredients for stimulating further economic activity to sustain, and even improve, the current level of economic growth in the country.	Appeal to common sense: "... rural areas, where about half of the people reside".	More information about the reform process at the Local Authority level: **SG2 (factual information)** Industrial and commercial development in rural areas is possible through good quality infrastructure; ignoring the human component: **DT 1 (technocracy);** Developing the physical and social infrastructure will stimulate economic activity and	Final reiteration of the way to global competitiveness with enumeration of spin-off benefits for the country.

	Text	Description (Text Analysis)	Interpretation (Discursive Practice)	Explanation (Social Practice)
			from this, good things will flow: **DT6 (pragmatism).**	

8. Interpretation

Two themes pertinent to our discussion emerge from the above analysis: the globalization "pull" that exerts a force on the Government to plan or initiate certain activities, and the need to develop the human resources of the country to utilize the infrastructure that will increasingly be made available to them.

8.1 Globalization pull

The reality of the global economy, and of the forces it is exerting on countries, societies and organizations cannot be denied. A country can be a part of the global economy in two ways: as a competitive player who will utilize the resources and opportunities of the global economy, and as a resource provider, because it has valuable resources "according to dominant values and interests" (Castells, 1999).

In striving to ensure that the country will not be part of the "excluded", the Government of Botswana seems to have made a choice to concentrate on the former role, that of being a competitive, active player in the global economy. No doubt, the second role of provider of resources to the global economy does conjure up images of exploitation and of being included as long as resources remain valuable or desirable, just to be excluded when this is not the case anymore.

If the view is held that Botswana is currently not an active player in the global economy, then the obvious question to be answered if the Government wants to pursue a course that would lead towards being an active global competitor is how this situation is to be reached. The Government of Botswana gives clear indications how they perceive this to happen: "Success in this regard can be achieved through vigorous implementation of appropriate policies, strategies and programmes" (Second speech: I,3). "Success" here refers to Botswana positioning itself for competing effectively in global markets. This is the objective, and all policies and action plans are aimed at achieving this objective. In this the Government displays a remarkable view that a society can be transformed mechanistically and through implementation of policies and measures: "....to guide the implementation of the Science and Technology Policy to make Botswana a knowledge-based society and a major participant in the competitive world" (Second speech: IV, 81).

The Government correctly recognizes that "the availability and use of information and communication technologies are a pre-requisite for economic and social development" (Castells, 1999) and announces measures to improve the core ICT infrastructure of the country. It fails, however, to explicitly recognize that "... an adequate level of education in general, and of technical education in particular, is essential for the design and productive use of new technologies" (*ibid.*) Thus, for example, it seems that the mere "connection" of 120,000 rural people is regarded as in itself constituting an act of progress towards more efficient and effective use of ICT.

We find the almost total focus of the Government on achieving global competitiveness curious. Global competitiveness cannot be achieved solely by providing ICT infrastructure and access to ICT – it requires, as a pre-requisite, a developed social infrastructure. While the Government recognizes the need for human resource development (First speech: III, 23; Second speech: IV, 81), all indications are that the Government expects social

development to be a by-product or consequence of technological development ("... making Botswana a knowledge-based society ...").

Of course, it is not possible for a developing country such as Botswana to follow a route of delaying entry into the global market while first addressing appropriate human resource development issues. The dilemma of developing countries is precisely this: to address both technological and human issues at the same time, and not to focus on one to the relative exclusion of the other. In contrast, we find the approach taken by Botswana to emphasize the technological, and to see the social as a necessary (but not so important) part of the *inputs* to the deterministic process that would lead to competitiveness in the global market from which a (convenient) part of the outputs would be the development of society.

This lack of emphasis on the social, at least collaterally with an emphasis on the technological, is an important deficiency in Botswana's approach. It impacts on both the success of achieving global competitiveness, and on the development of human resources, and this is taken up next.

8.2 Development of human resources

We have already, in section 6, stated our personal viewpoint on development and sustainable socio-economic development, based on the work of Todaro and Max-Neef *et al.* This is a subjective viewpoint, and is not held up as the *correct* viewpoint. It does, however, provide us with a basis for interpreting the viewpoint of the Government of Botswana as it emerges from the analysis of the two speeches.

Our viewpoint is encapsulated in the statement by Max-Neef *et al.* that "... fundamental human needs cannot, by definition, be structured from the top downwards. It cannot be imposed either by law or by decree. It can only emanate directly from the actions, expectations and creative and critical awareness of the protagonists themselves. Instead of being the traditional objects of development, people must take the leading role in development." (*op. cit.*, p. 39). This is in marked contrast to the approach taken by the Government who intends "making" a knowledge-based society from the top-down, and who sees human resource development as (just) an input to the process of achieving global competitiveness.

It is the prerogative of the Government of Botswana to develop and pursue its policies to lead the country into the global arena. Our recommendations, which we formulate below, should not be seen as attempting to prescribe to the Government, but as constructive criticism based on our subjective analysis of the approach followed by Botswana, and informed by our subjective viewpoints concerning issues surrounding globalization, human development and national policies.

9. CONCLUSIONS AND recommendations

It should be clear from what has been said above, that our preference would have been for Botswana to have in place a National Human Resource Development Concord as well as a National ICT Plan. We use the word "Concord" specifically to underline our belief that the development of people cannot be planned from the top down, but that there can be an agreement between all stakeholders and representatives on how human development would be approached.

If policies undertaken at the national level have an impact on all facets of social life, the decisions, actions and attitudes of the citizens also have an effect on the implementation and results of the policies. It would, therefore, be incorrect to think of development as only an economic problem. It is a cultural issue and one that pervades the entire organic being of a society. Financial inputs are necessary if the society is to invest in projects that will improve the lives of its members but they are not sufficient for a lasting and sustainable change; for that a cultural transformation would be needed (ICT Task Force Series 3, 2003). This cultural transformation of Botswana into an Information society is intended to be achieved through the Information Society initiatives of Government, which we view as interventions into the very fabric of Botswana society.

Viewing the proposals and actions of Government as interventions provides us with an approach that leads to constructive recommendations. We achieve this by using the so-called Human Environment Model (HEM) (Du Plooy and Roode, 1999). The HEM is a way of looking at the environment of an innovation which is introduced as an intervention into an organization (or a society) in order to understand the process of adoption and diffusion of the innovation. HEM views this environment as an integrated whole of six different social contexts of the

innovation. If we wish for more successful adoption and use of the innovation, we need to take cognisance of and *understand* this social context in its totality. If we cultivate and nurture all six "dimensions" of this social context, it does not necessarily follow that adoption and diffusion of the innovation would be successful. Such determinism cannot be superimposed on a process with so many non-deterministic characteristics. We may, however, expect that careful and continuous attention to all six dimensions or social contexts would increase the likelihood of success.

The environment we refer to here, into which the innovation is introduced, is the total society of Botswana. This environment is clearly very complex. It consists at least of the external environment which influences both the innovation and society, of interest groups within the society, of individuals and their societal activities as well as their philosophical beliefs and assumptions about work, society and technology. It also includes the complex relationships between all these elements.

In what follows we present a brief analysis of each of the six social contexts which, together, constitute the "human environment" of the innovation introduced by the Government. The six social contexts, although we discuss them separately, should not be seen as each having an "existence" of its own. The human environment is a whole, and cannot be separated into parts or into the six separate contexts.

The social context of the innovation

The Information Society initiatives as discussed in this paper consist of a number of components. In a more detailed analysis one would examine the social context of each of these components in so far as they could be considered to be "instrumental" initiatives. For now, we shall consider them together which is somewhat justified since they are meant to form an integrated set of initiatives.

The first point we wish to make is that each of the components, and the totality of the initiatives as a whole, should not be expected to have deterministic properties – i.e., one cannot assume that the effect of the initiatives can be determined *a priori* or predicted. Nevertheless, the initiatives will influence several aspects of the Botswana society, such as the communication between citizens and government; internal communication within government departments, financial discipline and economic activity. The influence will not only be at the procedural level: perhaps most importantly, the initiatives will alter significantly the values and judgments of the traditional Botswana society. It is this latter aspect that cannot be expected to happen just consequentially. On the one hand the initiatives will affect values and judgement, while on the other hand, changed values and judgements are necessary for the initiatives to take root firmly in the total Botswana society. This means that part of the Information Society initiatives should explicitly address the cultivation and nurturing of the values and judgments that will form part of the Information Society in Botswana – not by taking typical western-style value systems and attempting to import them into the Botswana society, but by extending the historical trajectory of Botswana value systems into a new future.

The social context of the environment

The Botswana society is continuously subjected to influences from outside – from international organizations and institutions, international suppliers and the world economy, and new innovations that render current technology less preferable if not obsolete. To put it simply: the world is not coming to a standstill while Botswana is introducing far-reaching changes. This means that part of the Information Society initiatives that will be introduced should address the ability of society to adapt to this ever changing "outside" world.

The social contexts of groups

"Groups" here refers to different segments of the Botswana society, such as different industrial sectors (manufacturing, ICT, the services industry, the health sector, etc); education, other government departments, etc. Each of these sectors will be influenced in a particular way that might differ from what another will experience. Each sector needs to develop a shared understanding of the changes that the Information Society initiatives would imply for them and has to address the resistance to change that would inevitably be exhibited within the sector. Equally important, each sector has to appropriate the initiatives and make them their own by internalizing the initiatives. This is not necessarily a natural process, and will have to be guided and nurtured. This means that part of the Information Society initiatives that will be introduced should address the ability of groups to internalize and shape the initiatives.

The social context of work

The Information Society initiatives have a very strong focus on transforming Botswana's economy into a globally competitive economy, with goals of increased productivity, and more effective and efficient use of resources. These all imply considerable changes in the work content and approaches of workers. Again, it

cannot be assumed that workers would simply embrace these changes. At the very least, the changes have to be smooth and have to extend previous approaches to work into a new future way of work. This means that part of the Information Society initiatives that will be introduced should address the traditional way of work in the various sectors and how they would be transformed to new ways of work.

The social contexts of individuals

The Information Society initiatives will affect every individual in Botswana. Some will be empowered, while others will be disempowered. Some will have their power bases eroded, and others will have their power bases strengthened and reinforced. The world views of many will be changed dramatically beyond the local to the global. Cultural values and traditions will be challenged. If all of this is expected to lead to, as Vision 2016 foresees, "*an educated and informed nation; a prosperous, productive and innovative nation; a compassionate, just and caring nation; a safe and secure nation; an open, democratic and accountable nation; a moral and tolerant nation; and a united and proud nation*", then part of the Information Society initiatives that will be introduced should include a considerable amount of consultation with individuals in society through the press, the television and through live interaction with politicians at meetings, rallies, etc.

The social context of the society

Society is not just the collective total of the individuals forming the society. It has, in a sense, a life of its own which is more than the sum of its parts. Thus, while it is extremely difficult to explicitly characterize a society's culture, norms and values, we know that differences between cultures and their norms and values do exist. It has also become clear that knowledge-sharing across cultures is far from straigtforward (see, e.g., Walsham (2001)). Much of the globalized world is based on western-style values and norms, and these are embedded in technology and approaches to work. Co-working in cross-cultural contexts often fail because the local, non-western culture is assumed and expected to conform to the dominant western-style of work. It is possible, as has been shown in many cases, to achieve effective co-working by developing, through joint efforts, appropriate cross-cultural teamworking styles and methods (Walsham, *ibid.*). Part of the Information Society initiatives that will be introduced should therefore include deliberate efforts to develop such cross-cultural styles and methods that are sensitive to the indigenous context.

Through this brief analysis of the various social contexts of the Information Society initiatives we have uncovered the following "recommendations". They have all been discussed in context above, and are therefore not further elaborated on. Naturally, a lot more can be said in very specific terms about each of our recommendations, but that would require a further and in-depth study.

Specific recommendations

Our recommendations are focused on two broad issues. Firstly, the Information Society initiatives should

- address the cultivation and nurturing of the values and judgments that will form part of the Information Society in Botswana – not by taking typical western-style value systems and attempting to import them into the Botswana society, but by extending the historical trajectory of Botswana value systems into a new future
- address the ability of society to adapt to the ever changing "outside" world
- address the ability of different segments of society to internalize and shape the initiatives
- address the traditional way of work in the various sectors of the economy and how they would be transformed to new ways of work
- include a considerable amount of consultation with individuals in society through the press, the television and through live interaction with politicians at meetings, rallies, etc.
- include deliberate efforts to develop, in situations of cross-cultural co-operation, cross-cultural styles and methods that are sensitive to the indigenous Botswana context.

Secondly, the Government of Botswana should have in place a National Human Resource Development Concord in addition to a National ICT Plan (adapted as recommended above). Such a Concord should address specific issues of human resource development and should move beyond seeing human resource development as (just) an input to the process of achieving global competitiveness. In contrast, the Concord should address the development of the basic capabilities of the human resources of Botswana needed to provide a solid foundation on which to build the Information Society Initiatives, and such development programmes should be planned in deep consultation with the communities and people involved in and affected by them.

10. Future Research

The problems we have highlighted in this article that could obstruct the best intentions of a National ICT Policy are not unique to Botswana. We believe that the approach that we have followed here could be of use to other developing countries who are grappling with problems imposed on them from outside through the forces of globalization, while struggling at the same time to address their socio-economic development. We caution strongly against the traditional approach of focusing on technological issues and expecting socio-economic benefits to accrue spontaneously. We do not advocate an exclusive focus on human development issues, but argue that such issues should at least receive the same attention afforded to technological issues. This is quite a demanding task: while technological infrastructure may be planned strategically, human development cannot be driven in an autocratic, top-down fashion. Unfortunately, without the necessary socio-infrastructure, even the "best" technological infrastructure would not achieve the results developing countries are aiming at.

Further research is planned in which the National ICT Policy initiatives of other African countries will similarly be analysed – not to just point out that they too lack the human dimension with regards to development, but to get a sense of whether the same approach could possibly be followed to enrich the policies with a focus on human developmental issues, as discussed above. In addition, we intend to establish an operationalization of the HEM model discussed above in order to further develop the recommendations that have been put forward here, and make them truly actionable.

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Maximising the Benefits of B2B E-Commerce by SMEs in Developing Countries: The Cluster Model Alternative

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ABSTRACT

The inception of the Internet, coupled with recent developments in multi-media applications and technologies, have brought with them electronic commerce practices which have greatly transformed the ways businesses are conducted globally. The result is that electronic commerce, particularly business-to-business (B2B) e-commerce, has witnessed an exponential growth in most of the developed countries where it has been successfully deployed and implemented. Unfortunately, however, as businesses in developed nations are reaping the benefits of these emerging technologies, their counterparts in developing economies, particularly those in sub-Saharan Africa, are bedecked by a litany of deployment and implementation problems which hinder their ability to exploit the benefits of these technologies. This state of affairs has contributed tremendously to the ever-widening gap which has come to be known as the digital divide. In this paper, an attempt is made to find a viable solution to these deployment and implementation bottlenecks in order to empower the firms in developing nations, especially the small and medium sized enterprises, to maximise their growth potential by reaping the benefits accruing from electronic commerce. The paper also examines the major impediments affecting the adoption and implementation of the B2B technologies in these regions and reports progress in the attempt to develop a suitable model for this purpose.

1. INTRODUCTION

The inception of the Internet has brought with it electronic commerce practices which have greatly transformed the way firms conduct businesses globally. Although the adoption of the Internet technology has occurred at a faster rate than any previous technology, the Digital Divide demonstrates that the changes brought about by this adoption have not occurred uniformly throughout the world (Jiang et al, 2000). This can be more amply demonstrated by the fact that in 2000, electronic commerce generated an estimated $830 billion in revenue in the US alone. This represents an increase of 58% and 156% over the 1999 and 1998 figures respectively (Collin, 2000; Ying and Anjana, 2001). Unfortunately, however, to date, there is little research carried out about the impact of Internet usage by commercial organisations in developing countries (Madon, 2003). Available statistics show that Africa is generally lagging behind in the adoption of e-commerce (Humphrey et al, 2003), with low level of B2B activities in the region (Jensen, 2000). The general consensus however, is that the Internet represents a tool for improved economic productivity. For example, the World Bank estimates rates of return to the local economy of between 13 and 20% (World Bank, 1995). Jayaram *et al* (1997) predict that the Internet will enable local companies to market their products and services abroad and thereby overcome one of the most important barriers to global competitiveness facing developing countries.

According to Turban et al (2002), the most prevalent types of e-commerce transactions in USA and other developed regions of the world are the business to business (B2B) and business to consumer (B2C). Of these two, B2B which has been growing exponentially since 1995 (Stuart, 2000), has also been credited with contributing more to the global economy than all other forms of e-commerce transactions (Barlett, 2001; UNCTAD, 2002).

There are three identifiable architectural models of the B2B E-Commerce. The classifications of these architectural models are generally based on who controls them, namely: the buyers, the suppliers or the intermediaries (Paltalidis and Georgiadou, 2002).

One of the architectural models is known as the "Supplier-oriented model". This enables the supplier to provide an e-store that offers the company's products and/or services to its customers through the Internet. There is also the "Buyer-oriented model" which enables a buyer to open an e-market and invite potential suppliers to bid on the announced requisitions for quotations (RFQs). And finally, there is the "Intermediary-oriented model" which enables a third party (an electronic intermediary company) to offer an intermediary e-marketplace for multiple business buyers and sellers (Turban et al, 2002; Burgstaller, 2000; Sara, 2000).

The identified architectural models have so far failed to adequately address the concerns of most SMEs in Sub-Saharan Africa (SSA). This failure can be partly blamed on costs, lack of IT skills and the problems of fraud (security), among others (Shemi & Magembe, 2003). In Nigeria for instance, there is the advance fee scam known as the '419' menace (Aniebonam, 2003) which brings the issues of trust and security to the fore. The general perception of Africa as a corrupt and fraud-ridden continent therefore does not help matters especially given the fact that the issue of trust is fundamental to the success of e-commerce (Keen et al, 2000). All these negatively impact on the adoption and implementation of existing models of B2B e-commerce in SSA.

Besides, these models are mainly technically-oriented and do not take into account some environmental and infrastructural issues, as well as the cultural aspects of the peoples living in the regions which are remarkably different from those existing in Europe and America. This therefore makes it imperative for a new model to be designed that would seek to reflect the unique characteristics of the businesses and peoples in the region.

The proposed model, aims to redress most of the problems already identified, and help the SMEs in SSA to leverage their e-commerce potential. This will in turn equip SMEs with the wherewithal to contribute more meaningfully to the human resource development as well as economic advancement of the countries in the region.

2. WHY THE FOCUS ON SMES?

This study is focussed on the small and medium sized enterprises (SMEs) in developing countries, particularly those in SSA with particular emphasis on the Nigerian situation. This attention becomes necessary as studies have shown that SMEs form the bedrock on which any country's economic growth and stability rests (Ojukwu and Georgiadou, 2004). As Twist (2001) established: "Small businesses represent more than 99% of all employers, employ 51% of private-sector workers, employ 38% of workers in high-tech occupations, provide about 75% of new jobs of the private sector output and represent 96% of all exporters of goods.

Furthermore, in 1999, the American economy grew dramatically, adding almost 2.8 million new, private-sector jobs. Of these new jobs, SMEs created about 75 percent with the services sector topping the list with about 1 million, followed by manufacturing, finance and insurance (SBA, 1997). The same story emerges in every other economy. The differences lie in the magnitude of impact and the indices for measuring them. In the United Kingdom, for instance, of the over 3.7 million active businesses operating in 2000, SMEs, including macro entrepreneurs, account for over 99% of UK businesses, and account for 50% of total UK turnover (£1 trillion), compared with 49% of turnover from the 7000 largest businesses (SBS, 2000).

In Canada also, SMEs deliver 60% of the country's economic output, generate 80% of national employment and 85% of new jobs (Varian *et al,* 2002), while they account for about 66% of registered jobs in Brazil (La Rovere, 2003).

Moving over to the developing countries, the role of SMEs is of an equally strategic importance. As evidenced by the rapid transformation of the "Asian Tiger" countries of India, Malaysia, Indonesia, Taiwan and Hong Kong, SMEs are a major catalyst to any country's economic development. According to a study conducted in Nigeria by the Federal Office of Statistics, over 97% of all businesses in Nigeria employ less than 100 employees and are therefore classified as SMEs (Ariyo, 2000).

There is considerable evidence to suggest that the introduction of new technology into organisations of all kinds and sizes has a major impact on the structure and functioning of the organization (Twist, 2001). The introduction of what Ojukwu and Georgiadou (2004) called 'IBIS' (Integrated Business and Information Solutions) contributed to the growth of some Nigerian SMEs . Similarly, the innovative use of ICT at the milk collection centres in Indian villages greatly contributed to the growth of milk production in the country (Bhatnagar, 2003). There is also the case of the adoption of the "Internet Business Solution" in the United Kingdom, France and Germany which resulted in current, cumulative cost savings of E9 billion (9 billion Euro) to the organisations deploying them (Varian *et al,* 2002). The argument here therefore is that since SMEs form the greater number of business enterprises operating in every country, equipping them with emerging technologies, such as the proposed model of B2B e-commerce, would help them improve their profit margins. These will also provide them with the needed impetus to invest more on human resource development through funding for education and specialised skills training programmes. It is hoped therefore that making this technology available and affordable to SMEs will help them leverage their growth potential which in turn may result in some measure of economic growth in those regions.

A case is also made here for the choice of Nigeria for this study. According to the World Bank Group (2004), Nigeria is an important country in West Africa because it accounts for 47 percent of the region's population and

41 percent of the region's GDP. With an estimated population of 132.8 million and a Gross National Product (GNP) of US$43.5 billion in 2002, the economic success or failure of Nigeria can affect not only the country but the whole of SSA. This is why any effort geared towards understanding how SMEs make use of emerging technologies such as B2B electronic commerce in improving their products and services, which ultimately reflect on their growth potential, is worth the while.

B2B is still in its infancy, especially among SMEs in Nigeria. We assume that by highlighting the Nigerian situation, this study would make similar impact in the countries around the SSA region as well as those in other developing countries around the world.

3. SOME B2B ADOPTION PROBLEMS IN DEVELOPING COUNTRIES

Considering the huge benefits derivable from the adoption of B2B technology, it is disappointing that most developing countries, particularly SSA countries, are still experiencing some very difficult adoption bottlenecks which deny them the benefits from this type of commerce.

Rao (2003) while investigating the criteria for assessing national e-readiness in developing countries, identified the "8Cs" checklist comprising 'Connectivity', 'Content', 'Community', 'Commerce', 'Capacity', 'Culture', 'Co-operation' and 'Capital'. Beyond semantics, most of the identified problems are similar to the checklist.

In a study conducted amongst SMEs in rural eastern Kentucky (USA), Wymer and Regan (2004) observed that the major factor stopping small businesses in implementing B2B e-commerce "is the cost and availability of resources and capital to invest in it". This is similar to the situation in most developing countries (Shemi and Magembe, 2003). Other studies have identified such problems as those relating to Personal Computer (PC) penetration, infrastructure, economic/political/business issues, culture and marketing issues (Fleenor and Raven, 2003). There are such other barriers as legislation, payment methods and financial resources as well as a relative lack of government interest in e-commerce (UNCTAD, 2001).

PC penetration is arguably the prime indicator of readiness for e-business particularly B2C. As Rabe (2001) and Singh et al (2001) observed, there is a direct relationship between PC penetration and e-commerce. It is encouraging to note that the number of Internet users in these developing countries has continued to increase (Sherif, 2002).

Okunoye and Karsten (2003) observed that the problem with the IT infrastructure is more pronounced in SSA than in India where the government has invested heavily in IT. Most of the problems in the SSA can be attributed to the government's lack of preparedness to commit sufficient resources to develop the national infrastructure, which could as a consequence improve the organisational infrastructures.

In India, apart from the famous "hole-in-the-wall" project hailed by experts as ground-breaking, there is also the SARI (Sustainable Access in Rural India) project which has led to improvements in health, empowerment, learning, and economic developments amongst the poorest and most disadvantaged communities in India (Warschauer, 2002; Mitra, 2002; Pentland et al, 2004). The SARI project using the DakNet technology - an adhoc network that uses wireless technology in providing asynchronous digital connectivity (ADC) leading to broadband connectivity - has provided affordable Internet services to the villages where it is operational (Best, 2002). SMEs, entrepreneurs and individuals in those villages now use the technology in providing e-services like email, voice mail, telemedicine clinics and some forms of e-government like tax returns and enquiries. There are also similar projects e.g. the Grameen Village Pay Phones and the Gyandoot Rural Intranet (Bhatnagar, 2003).

The African sub-continent has the potential to emulate the Asia/Pacific example in the development of e-commerce. However, the underlying problems that have militated against this development have to be redressed. Since successful e-businesses depend on a critical threshold of online users which constitute the precursor to a critical threshold of sellers and buyers, the first problem, is how to increase the number of Internet users in Africa (Fleenor and Raven, 2003). This argument can be likened to Metcalfe's Law, which explains that the value of a network increases with the square of the number of participants (Hanson, 2000). Closely related to the issue of Internet users is also the low diffusion of computers and telecommunications in desolate regions of SSA as identified by Avgerou (2002). For any meaningful progress to take place in the region therefore, this issue has to be reversed.

There is also the need to create a network system which can overcome the traditional topographical problems created by the nature of the African terrains. We postulate that DakNet (or any similar wireless broadband technology) should be adapted and deployed, more so as this is already working in Cambodia which shares some similar geographical characteristics with Africa.

Since, as Sherif (2002) observed, the number of Internet users in SSA is increasing, there is the need to address both the 'Capital' and 'Co-operation' issues affecting SMEs in these regions (Wymer and Regan, 2004; Rao, 2003). Shemi & Magembe (2003) also call for a new model of e-commerce that emphasises strategic alliance and collaboration amongst SMEs in Africa as existing models "favour large businesses that have the necessary resources". This underlines the need for the model being proposed here. It is primarily aimed at helping the SMEs which lack the capital to deploy these technologies on their own to pull their resources together (Capital and Co-operation) in order to improve the quality of their goods and services and maximise the benefits of emerging technologies.

4. RESEARCH OBJECTIVES AND METHODOLOGY

4.1 Objectives

The primary objective of this study is to develop a B2B model that will help SMEs in developing countries to leverage their e-commerce potential. This new model becomes imperative in view of the multifarious barriers which have continuously militated against the ability of SMEs (as well as a lot of the big businesses) operating in developing countries, particularly those in SSA in reaping the benefits of this new technology.

Furthermore, the study is aimed at developing a suitable model of B2B e-commerce which can empower SMEs and other organisations in these regions to contribute meaningfully towards the economic and human resource development of the countries in the region. As Okoli (2003) observed, "Rather than giving Africans the fish of foreign aid, it is critical that Africans learn to fish for themselves by developing viable economic models that fit well with their socio-economic environment".

The study also is intended to investigate and identify any other factors hampering the effective development of a viable and robust B2B e-commerce culture among SMEs in developing countries. This is with a view to proffering solutions on how these obstacles can be redressed.

Another sub-objective of this project is to examine the various forms of B2B E-Commerce models being adopted by SMEs in these regions and to explore why they have not had the expected impact on the fortunes of the companies adopting them.

Finally, the project seeks to have a trial-run of the developed model. This will be followed by further modifications and refinements in line with the cyclic model of project design and management before the final versions will be developed.

4.2 Methodology

This project is multi-faceted in nature. It therefore requires that a combination of different research methods will be used. The Qualitative and Exploratory Research Method will be used for this study because it is necessary to identify the various factors militating against the development of a robust B2B e-commerce in SSA and fashion the best way to overcome these obstacles. To do this, the opinions of some of the key players in SSA, especially those in Nigeria, will have to be sought using the Interview-based survey technique (Clarke, 2000; Miles and Huberman, 1994; Cornford and Smithson, 1996).

The Survey Method (with the "empirical materials" being generated mainly by administering the Questionnaire to the respondents) will be used for capturing the data from SMEs. This will shed more light on the people and the social and cultural contexts within which they work (Myers, 1997; Clarke, 2000). It will also highlight their problems and prospects. Follow-up interviews will be conducted amongst the operators of SMEs in Africa in order to throw more light on some of the data captured in the Questionnaire.

A critical evaluation of some SMEs in Nigeria that have successfully adopted B2B e-commerce in their business activities will be made in order to identify additional factors that contributed to their success. Their operational problems will also be highlighted.

Finally, the data generated from both the Survey and Semi-Structured Interviews, as well as other relevant sources will be used in refining the model that is envisaged to provide a suitable, flexible, profitable and reliable platform for the adoption and implementation of a viable B2B E-commerce for the SMEs in SSA.

5. TOWARDS A SUITABLE MODEL

The model being proposed in this study has so far been called the "Cluster" model. It is in line with the "Strategic Alliance and Collaboration" suggested by Shemi and Magembe (2003). This model operates on three main levels: Internal, Collaborative (Semi-External) and External as shown in Fig 1. It proposes that each participating SME controls some of its core operational and legacy systems at the Internal level, while sharing its marketing and other business processes with other participants at the Collaborative level, within a virtual private network (VPN). The third level (External) is where the whole group shares their products and services with the world through the Internet.

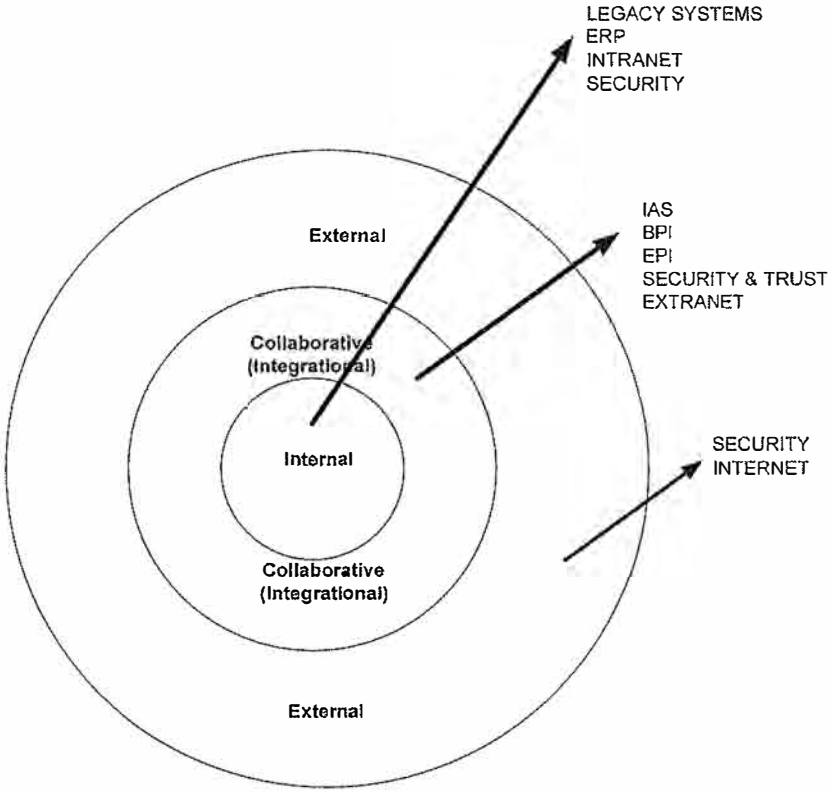

Fig 1: Showing 3 Levels of B2B Cluster Model

Each of these levels consists of a number of components. The Internal level has 4 components, while the Collaborative and External levels have 5 and 2 components respectively.

As shown in Fig 1, the main components of the Collaborative level are the Integrated Applications Solutions (IAS) e.g. Databases and Catalogues; Business Process Integration (BPI), e.g. New Product Development (NPD), Product Development Management (PDM), Business Model Development (BMD), Business Strategies Development (BSD), etc; and Enterprise Process Integration (EPI), e.g. Quality Assurance Management (QAM), Human Resources Management (HRM), Customer Relations Management (CRM), Supply Chain Management (SCM), Database Management Systems (DBMS) and Risk Management (RM); Security and Trust, as well as the Extranet layers.

The major components of the Cluster model are represented in Fig 2. This model proposes the formation of a strong working relationship among SMEs with a view to pulling their meagre resources together in order to maximise the global B2B e-commerce opportunities.

The Cluster model is currently in its design stage. It is envisaged however, that in this new model, SMEs offering different products and services can operate collectively at both the Collaborative (semi-external) and External levels, while maintaining their individual operations at the Internal level. Cluster members will have shared databases and catalogues from where details of their products and services are published on the Internet (External level). This mode will help the participating SMEs to streamline their business activities and to process their business dealings and communications with their customers.

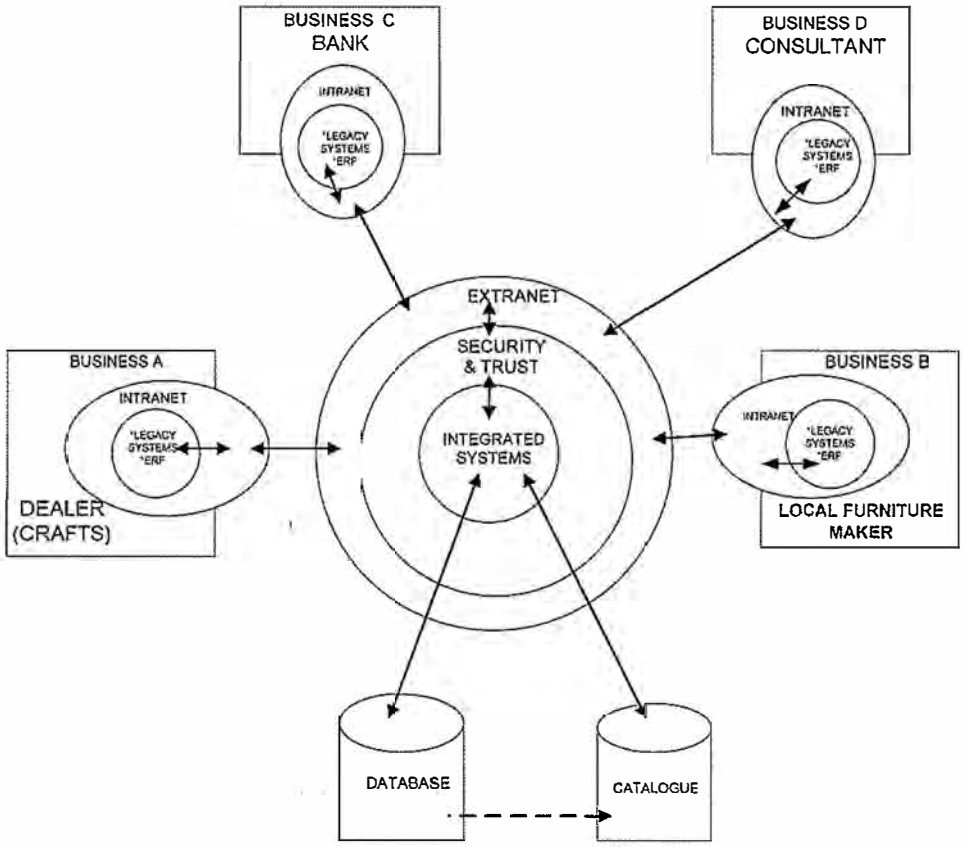

Fig 2: Architectural Overview of Cluster Model Relationships

Some of the facilities to be shared include the Integrated Applications Solutions (IAS) and Enterprise Process Integration (EPI) which requires the Cluster members to have platforms that are both compatible and interoperable. This will be followed by the Business Process Integration (BPI) which will enable the members of the cluster to know what each other does, what products and services they offer and what their niche markets are. It is at this level that common Brochures, Catalogues and Price Indices are defined, described, codified, and price-tagged and produced. All these will take place in the Extranet level and should be characterised by mutual trust and security.

The next level is the External level which provides the point of contact with other businesses either as dealers, buyers or even intermediaries. This is the point at which the Internet platform becomes relevant to the group.

6. ENVISAGED BENEFITS OF THE CLUSTER MODEL

The stakeholders in this model include the government, SMEs, consultants, banks, citizens of these developing countries as well as the world in general.

For the SMEs, it is envisaged that adopting and implementing this model will drastically reduce their transaction costs, while at the same time increasing their efficiency and profit margins. This will be achieved through having greater freedom to streamline their business activities and to process the communications with their customers. The model also will bring about enhanced quality and competitive goods and services to the SMEs adopting it.

Furthermore, since the human resource management (HRM) functions of the group would be handled by a member of the group (see Consultants in Fig 2), it is hoped that there will be a marked improvement on the quality of new recruits as the consultants will only hire people who are suitably qualified for the jobs. This is very important because, as Mason et al (1996) and Prais (1995) observed, the supply of appropriately skilled labour is key to the success of a firm's quality strategies and the effectiveness of its management system.

It is also envisaged that there would be a more efficient, cost-effective and result-oriented way of conducting in-house training to enhance both the human resource development of the staff and help group members meet their challenges and competences. The net effect would be more employee job satisfaction and improved morale, as well as efficiency and productivity which in turn would result to growth of the businesses in the group (Bartel, 1994; d'Arcimoles, 1997).

To the governments in the regions, there will be increased revenue through taxes, tariffs, etc, as well as stronger economies. There will also be more employment opportunities; more profits for vendors of communication, software and hardware technologies; more social amenities, more quality lifestyles, health, learning, cheaper and more quality goods and services, etc.

In a buyer-oriented marketplace, buyers will be able to buy quality goods and services from around the world. Suppliers also benefit from the extended geographical market reach and the lower sales and marketing costs. Also, by improving the productivity of bidding and sales activities, and by reducing the selling cycle time, sales are boosted (Malenski, 2000; Liebman, 2000). The customers will enjoy assured security and trust since they know that they are dealing with genuine, trusted and reliable group of operators. This will help in developing trust which will grow, over time, into the creation of credit facilities, etc.

The issue of trust is fundamental to the success of the whole set up. It is the foundation of e-commerce (Keen et al, 2000). Trust involves having confidence in the other parties, and hence having an expectation that the risks will not result in loss (Clarke, 2002).

Yee (2001) gives some of the features that lead to trust as: competence, credibility, integrity, benevolence and communication. Trust also creates a smooth process that would in turn foster smooth participation, policing the activities of the individual member of the group, avoiding bureaucracy in the systems and reducing the over-reliance on technology.

The higher the trust, the more the customer loyalty, as experience is a factor to increase trust in new products and services. It is our expectation that the e-commerce market would more readily trust this model over time than they would trust an individual SME operator.

Over and above all others however, there is the benefit of a level-playing field which the SMEs in developing economies, like Africa, can capitalise on to leapfrog, improve and sustain their economic development and global e-business participation.

7. SOME ANTICIPATED PROBLEMS OF THE PROPOSED MODEL

In spite of its inherent advantages, this proposed model has potential weaknesses such as the building of trust among participating SMEs, and the integration of the SMEs' disparate business processes.

Furthermore, as each SME is coming into the Cluster with its own business culture, it is anticipated that streamlining these cultural differences will take some time to achieve. However, as soon as this initial problem is overcome, the members stand to reap the benefits which this model provides.

8. CONCLUSION AND SUMMARY

In this paper, the Cluster model of B2B electronic commerce is recommended for SMEs in developing countries. The model operates on three levels and has its strengths and weaknesses most of which have been explored. The world needs to totally bridge, or at worst, narrow the digital divide between the developed and the developing nations. One of the ways to achieve this twin ambition is for SMEs in developing countries, particularly those in SSA, to be empowered to maximise the benefits of B2B e-commerce. Since all other models of this technology have so far failed to lift the economies in these regions, the proposed Cluster, when fully developed, may be the road that leads to a sustainable and viable development in these regions.

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SESSION B4: RESEARCH PAPERS: IT & HR DEVELOPMENT IN EDUCATION AND LEARNING

The Relevance of Local Dialects to ICT Advancement in Developing Countries: Yoruba Language as Case study

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ABSTRACT

Basically, a language is the soul of culture and the death of any language will spell the death of its culture. The language issues are deepening the wound that the digital divide is inflicting on developing countries, most especially African. The available technology, which should aid in problem solving, is not appreciated by the downtrodden as a result of language difficulty. This is a hindrance to the general acceptability of Information Technology (IT) or computers at the grassroots.

The objective of this work is to develop a Yorùbá based interpreter that will enable the Yorùbá speaking communities to communicate and program computers in their dialect. The work, an interaction between computer systems and human interface is seen as an aspect of Information Communication Technology (ICT) study whose primarily aim is to study the effect of local language to ICT momentum in developing world. The implementation logic of the interpreter employed in this paper consists of the parser specified using recursive descent, and a database implemented using a hash table. Backus-Naur Form was used to define the grammar of the simple language. The modules of the program are developed using Borland C++ Builder programming language.

A simple experiment was conducted to verify what effect the use of local language in ICT might have in human resources development. The result of the experiment showed that the use of local language in ICT can improve people's consciousness about ICT which if harnessed will enhance human development through knowledge sharing since the software content will be tailored to the social-cultural context of the audience in question. The long term effect of which is to eradicate or reduce the level of illiteracy.

1.0 INTRODUCTION

Computers are so essential to modern society that without them, our economy would grind to a halt (Norton, 1996). They are such flexible tools that human beings in every facet of life use them every day. Before now, one could do things without any thought of Information Technology, but not today! Information Technology has changed the face of things. E-mail can be sent and reply received almost instantaneously. Information Technology (IT) has sneaked into the lives and homes of those who live on earth today. And it will soon get better, or worse, depending on which side of the "digital divide" (the gap between the technology haves and have-nots) one is located. The developed world (West) discovered these unparalleled remarkable features (characteristics) of computer early and used it to better their lots in terms of economic growth and development. This however, cannot be said of African nations that are still battling with instability and poverty. The earlier handling of IT may have closed the door on the illiterates by creating an idea of IT being a pure technology phenomenon rather than the tool of life it's supposed to be. Time and events have proved that any form of technology is the application of science in solving the puzzles of life.

It is worthy of note that many citizens of developing countries have no opportunity to a good school education. Teaching computer basics can be a very arduous task, specifically if computers are not available, and even when they are, the language issues are deepening the wound that the digital divide is inflicting on developing nations. If technology, which should be used to solve problems, is not understood, the intending beneficiary will not have his problem solved. This effort of ours will to a large extent, offer the Yoruba speaking nation especially the illiterate, a localised software that will make them use computers or ICT to better their fortune by making computer provide them information that is relevant to their daily needs. The focus of this paper is to describe the structure of a simple interpreter that translates instructions in Yorùbá language to equivalent machine form, and also to demonstrate the consequence of using local language in ICT to better the lots of people in developing world. In section 1.1, we discuss African languages, vis-à-vis its current state and importance in information age and development, while section 1.2 introduces interpreters. Reasons for adopting Yoruba language for the development of the local interpreter are giving in section 1.3. We propose our model interpreter in section 1.4.

Materials and methods used in the experiment is discussed in section 1.5, the result of the conducted experiment is presented in section 1.6. Challenges and prospects of the system are given in section 1.7. Areas in which the system can be improved are given in section 1.8, and finally, a concluding remark is made in section 1.9.

1.1 AFRICAN LANGUAGES-THE PRESENT STATE IN INFORMATION AGE AND IMPORTANCE

Unfortunately, computers, software and the Internet do not seem to understand or promote content in some languages, most of which are the languages of the black race. A recent study established that most human languages today are spoken by exceedingly few people. In fact, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) raised alarm that majority of languages will soon vanish. Close to half of the 6,000 languages spoken in the world are doomed or likely to disappear in the foreseeable future. (Wurm, 1996). The impacts of rapid growth in urbanization, Westernization and global communications are some of the forces that have been known to aid in diminishing the self-sufficiency and self-confidence of small and traditional communities. Also taking their toll of languages are the discriminatory policies, and population movements to the West. Africa has been at the receiving end in world development. More than any other continent in the world, the continent has lost most of its indigenous languages through foreign culture and modernizations. Knowing fully well that the people's language is their being and identity; African scientists and researchers must strive to ensure the inclusion of as many African peoples as possible in the information society by making mother tongues relevant to information technologies. It is in the light of the foregoing that the authors try to create awareness concerning the danger of loosing our identities due to negligence. It is our belief, that the techniques used in the development of the system can be made available as intellectual foundation for work in other African languages. People across the world are awake to the reality of saving their mother tongues from extinction, we Africans will not just look on and fold our arms.

Spectacular revelation of note is the importance of mother tongue in the national development. It is hypothesized that understanding is more enhanced when a child is instructed in mother tongue. A language is an artificial and consciously organised method of control by the use of symbols of conventions (Wilson, 1968). A language is also a process for transmitting culture in terms of continuity and growth for disseminating knowledge either to ensure social control or to guarantee rational direction of the society or both (Fafunwa, 1989) hence teaching in mother tongue will contribute to the improvement and understanding of one's consciousness. This conscious awareness should lead one to exercise control over the environment so long as meaning is given to the various features in the local environment. It is to be noted that without effective instruction in mother tongue, it is almost inevitable that rather than naming the features in the African world by ourselves, so that we can act on them, foreigners will give them names to act on us. This point was expressed succinctly in (Sadler, 1972). Africa's development will only come when it is tied to its culture with language as the anchor. Asian countries like Japan, Thailand, Taiwan, Malaysia, and Korea among others are good examples of countries with culture-based developmental plans. These countries learn science in their own languages; hence, they have rapid technological advancement.

1.2 INTERPRETERS: WHAT ARE THEY?

The three levels of instructing a machine are: Machine language (difficult but flexible), assembly language - which is closer to the hardware and the high-level language (English like) that makes programming easier and simpler for users. Most users however, prefer to instruct computers using a high-level language. Based on the disparity of language between humans and computers, a translation system is therefore needed to convert high-level user instructions to its equivalent machine codes. The translation system can be implemented as a compiler, an interpreter or a combination of both (Aho et. al, 1979).

An interpreter translates source code into groups of machine instructions and immediately executes those activities (Bauer et al, 1976). The first interpreter to be developed was BASIC at Dartmouth College in 1964 by John Kemeny and Thomas Kurtz (Mckeown, 1993). Other examples are GWBASIC, Turbo Basic, and Visual Basic.

Despite the fact that most existing interpreters are DOS (Disk Operating Systems) based, they typically accept and interpret the standard keywords (instructions) in English, which makes it a Herculean task for a user with no

understanding of English to interact or instruct a computer. This may further lead to a widening of the digital divide.

1.3 RATIONALE FOR USING YORÙBÁ AS A PILOT TEST

It is true that today's computing environment places strong emphasis on the adjustment of the software contents and appearance to the socio-cultural context and functional needs of the target audience. Hence, many software houses realised the importance of local languages and therefore localised their software for different languages. There are Microsoft products in Japanese, German, Greek, Spanish, French and English. For example, we have Chinese Microsoft Windows ME and L&H™ Voice Xpress™ Spanish, which enable Latin American Spanish to improve their productivity by dictating, editing and formatting documents. Also, as the information revolution worldwide becomes increasingly multilingual, coupled with the introduction of new technologies in every nook and crannies of Africa, major effort of numerous organizations and development programs globally has been to make computer available for everyone. Language, electrical power, literacy, and personal wealth are some of the difficulties thwarting participation in the digital revolution. Yoruba language was used as a case study based on the following reasons:

1. The Yoruba language belongs to the Benue-Congo branch of the Niger-Congo language family (Britannica, 2004). Yoruba culture covers the states of Lagos, Ogun, Oyo, Ondo as well as part of Kwara and Kogi states of the middle belt region, all in Nigeria. Yoruba is also spoken in the neighbouring countries of the Republic of Benin, Togo and Sierra Leone. In fact, the trans-Atlantic slave trade resulted in the forced exportation of a large number of Yoruba into the Americas where, as in Haiti, Cuba, Brazil and most Caribbean Islands, they have remained as the largest single group of African people in the Diaspora (Asiwaju, 1983, Cutin, 1972 & Fadipe, 1970). Based on the number of people that speaks the language as shown in table 1, the political, cultural, and social importance of the language within Africa and the world at large cannot be overemphasised. The Yoruba speaking population globally is estimated at approximately 100 Million people (Laniyonu, 1997).

Table 1: Yoruba Speaking Nation Globally

Country or continent	Population
Nigeria	56 million
Rest of W/ Africa	10 million
Rest of Africa	5 million
UK	5 million
Rest of Europe	5 million
North America USA & Canada	10 million
Cuba	1 million
Rest of Caribbean	. 5 million
South America Brazil etc.	5 million
Asia	2 .5 million

2. Yoruba language was the first Africa language to be written (Campbell, 1991). It was written in the 1800s, so it has a matured orthography. Moreover, numerous textbooks expressing scientific and mathematical concepts in Yorùbá language are available (Fufunwa, 1989).

These reasons served as stimulants to the design of a subset interpreter for the Yorùbá language. For simplicity and uniformity sake, the standard Yorùbá language used for educational purposes (in the newspapers, on the radio, and in school) is chosen for the design of the interpreter, since speakers of the various dialects understand this form. The Yorùbá character set adopted by Ajayi Crowther in the 1850s after due consultation with scholars and missionaries in Europe, Freetown and Abeokuta has remained essentially unmodified till today (Campbell, 1991). It consists of 25 alphabets with vowels that can have either of two diacritical marks on top (acute or grave) or none.

1.4 THE MODEL OF THE SUBSET INTERPRETER

The subset interpreter carries out compilation process on user's instructions. The operational details and importance of the compilation process is described in (Bauer et al, 1976). Figure 1 describes the phases of the interpreter, while figure 2 presents the captivating system's welcome screen. The detailed technical specifications of the system are defined in (Ajayi 2003).

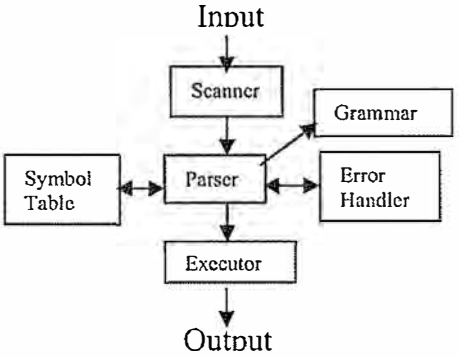

Figure 1: Phases of the subset Interpreter

Figure 2: Welcome

- Scanner- The scanner groups the input stream into tokens and constructs a symbol table that is used later for contextual analysis. The tokens include keywords, identifiers, operators, constants, and comments. The scanner is implemented as a finite state machine.
- Grammar -A grammar impacts a structure to a program that is useful for its translation into object code and for the detection of errors (Aho et al., 1979). It is specified using Backus Naur Form whose design is based on Context-Free Grammars.
- Error recovery and reporting -It enables the parser to detect error, issue appropriate error message and then continue the parsing process probably to find further mistakes.
- Symbol Table - The symbol table is a data structure used to store the names encountered in the source program and relevant attributes.
- The Parser- The parser groups tokens into syntactical units. The design of parser is based on the Recursive Descent compiling. The degree of success with which the parser for the Yoruba interpreter diagnoses syntactic errors and recovers from unusual situations can be appreciated by considering the sample output in figure 3, which illustrates the addition of two numbers (2 and 4). There are three windows in the figure- the code window (where instructions written in Yorùbá are entered), the output window (where results are displayed), and the message window for displaying error messages and compilation status information to the users. The accuracy with which results are produced and the speed of execution has been found to be outstanding when compared with other existing interpreters (Ajayi and Adagunodo 2004).
- Executor- This module executes each instruction line by line. It uses a stack to evaluate instructions.

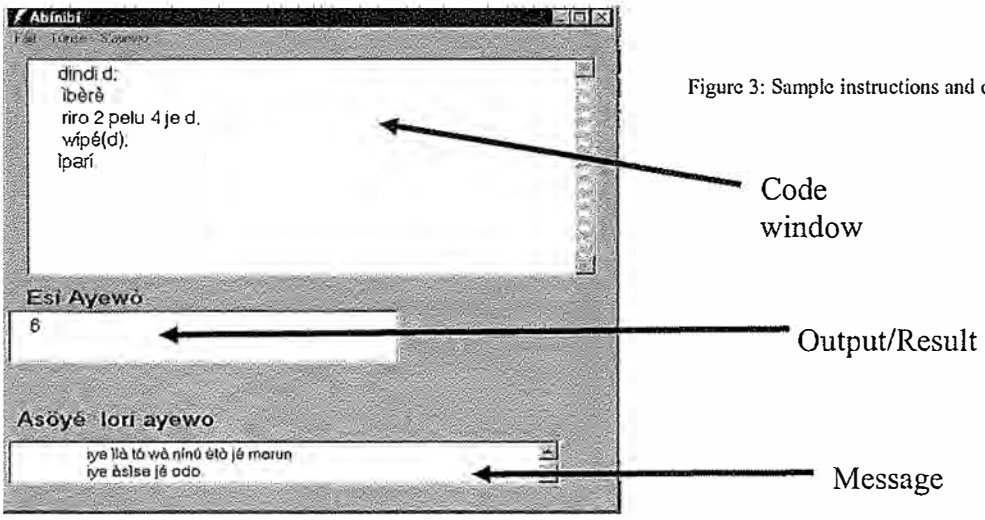

Figure 3: Sample instructions and output from the Interpreter

A simple experiment was conducted to find out the impression of people about computer/ICT in the rural areas, and also to determine what effect the use of a local language in ICT may have in human resources development. In the experiment, three schools in the three local government councils of Osun State, in Nigerian namely Ife Central, Ilesa West and Irewole were used. Twenty students with ages ranging from eight to eleven were randomly selected from each local government areas. These students were taught the fundamentals of programming computers using two languages (methods) – first in Yoruba and then in English language, for a period of four months (August 2003 - November 2003). The students applied the theory taught by using a well-known dialect of BASIC interpreter -GWBASIC and an interpreter in mother tongue – christen Abinibi, to instruct (program) computers. Oral and written examinations in BASIC and Abinibi were conducted after the preparation. This category of students in the experiment is referred to as Class A. Class A student's scores in all the local government areas were collected and analysed for equality of means using t-test available in SPSS package. Class B students consists of randomly selected students (ages between eight and eleven) from the same local government areas as those for Class A students. They were taught both the theory and practical concepts of computer programming directly in English language. Examination in GWBASIC (a programming language) was also conducted after the preparation. Average scores obtained by all students in each local government areas were noted and recorded.

1.6 RESULT

Table 2 illustrates the result of analysis of Class A students; it showed that there is significance ($0.000 < 0.05$) between the two methods of instruction, even though they all performed above average in the two methods of instruction. Table 3 shows the average scores obtained by Class A and Class B students. The result obtained for Class B students was not too encouraging, the students found it hard to understand computer programming concepts. This revelation goes to confirm that Class A students performed better in both languages –Yorùbá and English, because they were first introduced to computer programming concept using local language, while the Class B students performed well below average. Hence, the use of local language in ICT can positively influence human resources developmental program. Also, people can harness the full benefits of ICTs in all aspects of their lives- home and work, if the language in which the content of these devices are written is familiar to the background and culture of the people in question. Figure 4 is a bar graph of means against Local Government Councils, while Figure 5 shows average scores of Class A and Class B students in GWBASIC examinations. It was also discovered that students found it much simpler and easier to instruct computers in local dialect when compare to the time they spent in learning other foreign computer programming languages. One major achievement of the experiment is that a sizeable percentage of the students used in the experiment enrolled in computer schools and completed their certificate programmes in computer studies successfully with greater ease and had proved decidedly self-reliant and more resourceful individuals. We were inspired and encouraged to see the effect of this on the rest of the students some months later, they all wanted to be computer literate. In fact, a school in one of the local government councils used in the research had to look for funding to get a computer for her students' use.

Table 2: Independent Samples Test for Abinibi and GWBASIC

Ife Central Local Government							
					t-test for Equality of Means		
Methods	N	Mean	Std. Dev	Std. Error	t-value	df	Significance
Abinibi	20	73.2	6.925	1.549	7.947	38	0.000
GWBASIC	20	55.0	7.546	1.687			
Ilesa West Local Government							
					t-test for Equality of Means		
Methods	N	Mean	Std. Dev	Std. Error	t-value	df	Significance
Abinibi	20	69.2	12.094	2.704	5.727	38	0.000
GWBASIC	20	50.7	7.901	1.767			
Irewole Local Government							
					t-test for Equality of Means		
Methods	N	Mean	Std. Dev	Std. Error	t-value	df	Significance
Abinibi	20	67.4	11.028	2.466	5.380	38	0.000
GWBASIC	20	49.9	9.425	2.107			

Table 3: Average scores of Class A and Class B students

Class	**Language**	**Ife**	**Ilesa**	**Irewole**
A	GWBASIC	55%	50.7%	49.9%
B	GWBASIC	19.5%	14%	17.5%

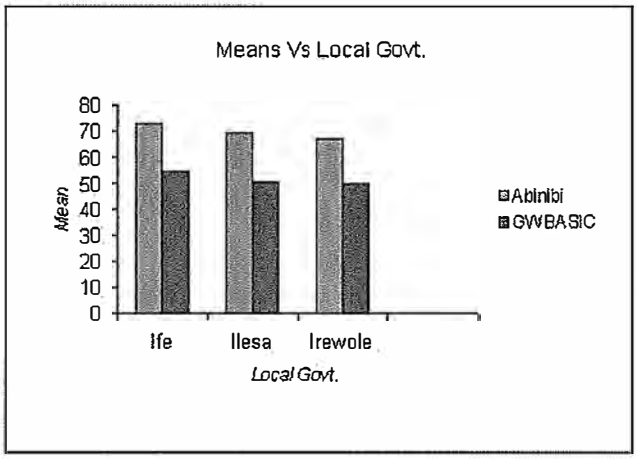

Figure 4: Bar graph showing the performance of students in Abinibi and GWBASIC

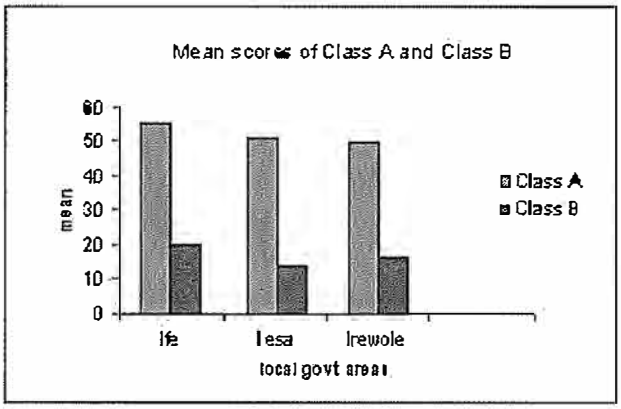

Figure 5: Average scores of Class A and Class B students in GWBASIC examinations

1.7 CHALLENGES AND PROSPECTS

The working model of the system was introduced to students dispersed in three schools located in the rural communities of the Western parts of Nigeria. Students' feedback is generally very positive with many expressing interests to have computer studies introduced to their curriculum even at the very tender age. Sixty students participated in the survey. The following is a summary of student feedback. Note that the total does not equal to 100 percent for some row due to missing values.

Do you find the system useful	YES 95%	NO 0%	Not sure 5%	
Ease of use of the system	Very Easy 70%	Fair 25%	Poor 0%	
Complexity of statement structure	Very Simple 66%	Simple 24%	Fair 10%	Poor 0%
Overall Ranking	Very Good 60%	Good 35%	Fair 0%	Poor 0%

All of the students who responded find the system useful to some degree. Most are trilled by the simplicity of the system and found it very easy to use. This is not surprising, as most students in the rural communities found it comfortable to communicate with each other in local dialect, hence making them feel at ease to communicate with computer.

Generally, key prospects of the project are:

- Creating ICT awareness among people, whether literate or not. People will be proud of their culture and fulfilled when communicating with computers in their own language and not in another language. This will make more people accept ICTs and rely on it in their daily endeavours
- Enhances human development through knowledge sharing. Harnessing ICT in distribution of educational information and knowledge especially when the content of computers and other ICT devices are clear to the majority of people in that locality tends to reduce illiteracy level.
- The project has discovered potentially huge markets for Western Communications products in Africa only if local cultural issues (localisation of software) are taken into consideration.

1.8 FURTHER DEVELOPMENT

The system is fairly well developed, however further development is directly in progress to enhance its utility by developing additional software modules. Some of the planned extensions to it are:

- Extending its capability by including all the features of a modern programming language, such as file handling routines, string manipulations routine, graphics etc.

- Enhancing the programmer workbench environment- a word processor capable of spell checking and grammar correction of Yorùbá text. The suite of which may be used in e-mailing.

- Incorporates a module that will enable people to speak directly to computers by dictation rather than having to enter the instructions via the keyboard.

- Since the Internet is what is in vogue currently, a project is on the pipeline to develop Yoruba websites that will be of great benefit to people that can neither speak nor write in English.

1.9 CONCLUSION

Much of the work presented in the paper is concerned with the design of an Interpreter that converts and subsequently executes instruction given to computer using Yorùbá keywords. The major aim is to verify what impact the use of local dialect in ICTs will have on African's development, especially the huge population of illiterates in the rural communities. It presents framework that assists people with no knowledge of English to catch up with the ICT world. The work also discovered that in other for the ICTs to transform the economic and social activities of these people, the language in which the content of these ICT devices are written should be familiar with people's local dialect. When this is done, ICT can be harnessed as a knowledge sharing tool to disseminate educational information and knowledge among people. This on the long run will reduce the level of illiteracy. The experience in Italy and China (ChinaMirror, 1999) reveals that the populace adopted the internet facilities very rapidly when the services became available in their local languages.

It is also our belief that this work will aid in the rapid integration of computers both in the urban and rural areas in Nigeria and by and large Africa. ICT Stakeholders should strive to ensure that ICT benefit everyone, regardless of location, occupation, language, or financial issues. If ICT must be used to better the life of people in developing world, Africa in particular, then it is indeed essential that the language used in ICT must be understood by the people. By so doing, people will be enriched by the sharing of knowledge, culture, and information.

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Nigerian University Software Development Training: From Building Walls to Building Bridges.

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ABSTRACT

This paper presents some results from Information System Development for Health in Africa Methods (INDEHELA_M) project, a just concluded research. that informed the current research sponsored by Academy of Finland through INDEHELA_Context project. It recognises the rapid diffusion of IT today which, unfortunately, has not been accompanied by substantial benefits in many developing countries. The huge expenditure being incurred in the acquisition and use of Information Technology (IT), and the failure to realize comparable socio-economic returns from such investments has informed the research in software development chain of activities.

INDEHELA_M investigated the existing software system development practice in Nigerian software industry between 1998 and 2001. The research revealed that the software companies are between 130 and 150, and they clustered around Southwest part of Nigeria. The industry line of business is private sector oriented, and the focus is application system development. The study also revealed that the Nigerian software market is dominated by foreign packages, hence the unprotected software industry mostly offer services to maintain these foreign software products. Also the software product implementation in Nigeria hardly re-engineers the user organisations.

The research also revealed that university software training programme does not prepare the students for immediate work demand in the industry especially in some specific areas of software development. This is being addressed in the INDEHELA_C project where a collaborative training programme between software development companies and the university department is being tried out at the computer Science and Engineering Department, Obafemi Awolowo University, Ile-Ife Nigeria.

INDEHELA_C proposed that the socio-technical factors and demands that the university systems are burdened with in Developing Countries should make educational solutions and their organisation a top priority. The solution should be functional, practicable, and agreeable to all parties. It should address the problems identified by the industry and project beyond the immediate demands of the industry.

INTRODUCTION

There has been a rapid global diffusion of information technology (IT) not just in industrialised but also in developing countries. The gap between the huge expenditure/expectations associated with IT and the failure to realise clear socio-economic returns from such investments has informed INDEHELA_M research project reported here.

One of such pathways to training in software development is short courses organized by some IT companies or in-house training. A divergence from these trainings is more emphasis on preparing professionals as opposed to researchers, although the university programme (at least at the first degree) is flexible enough to allow those interested in research careers or professional careers to pursue them.

The research covered 47 Nigerian Universities (24 Federal, 18 State and 4 Private), but only 26 (17 Federal, 8 State, and 1 Private) offer courses in Computer Science, 23 of the universities award Bachelor degrees while the

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other three award only certificate. Only the universities who offer courses in software development were included in the analysis since universities are the main suppliers of IT professionals in Nigeria.

The INDEHELA_C part that focuses on software development and education research validates the results from the former project and seeks to know if the industry collaboration with the university can improve the software development education in the universities. The overall research focus is as depicted in Figure 1 with the main objective of improving the human resources in Software System development in Nigeria. Software development is a chain of activities where one affects the other as shown in the Figure. Drawing from the strengths of the software development industry, the weaknesses in the software education in the universities is improved through the INDEHELA_C research project using Computer Science and Engineering department Obafemi Awolowo University as a case. The selection of the university is because the first department of Computer Science and Engineering in Nigeria was established at Obafemi Awolowo University. The number of students that has graduated from the department till now is the highest in the country. They are pioneers in most of the Computer Companies in Nigeria.

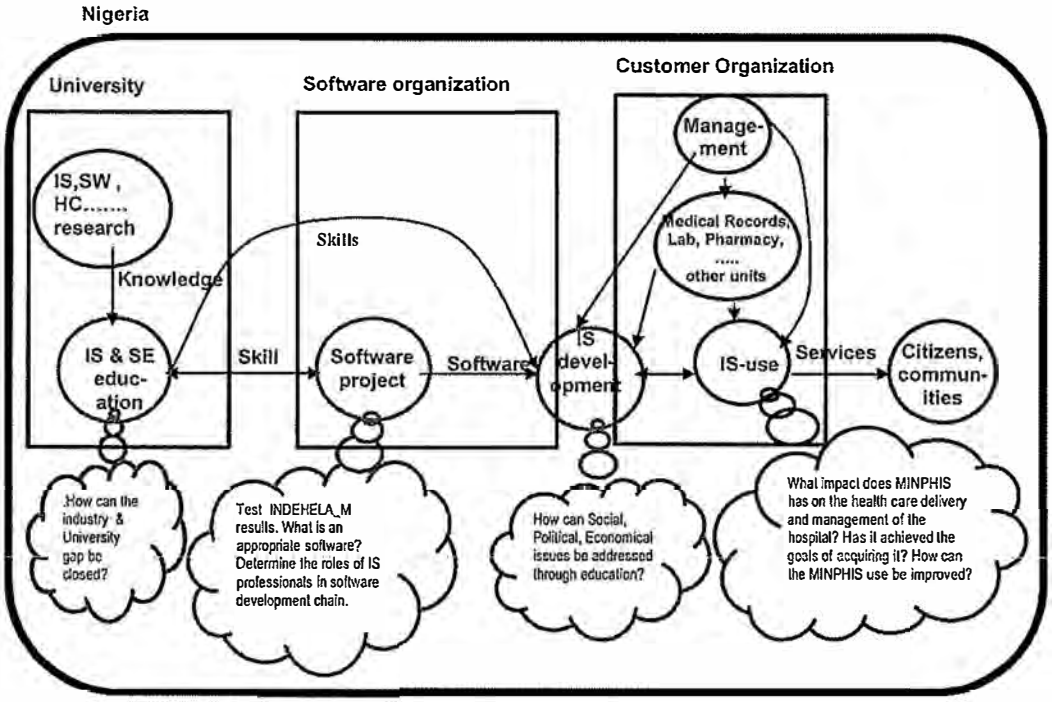

Figure 1: IS and SE education Research Framework

The main question is how the deficiencies identified in the software education in Nigerian can be eradicated, reduced or how can the software industry collaboration with the university teachers to provide appropriate education for building the industry standard software. Four countries in Africa and Europe are participating in INDEHELA_C research project. The paper presents the previous research results that relates to software development education, then the project setting in Nigeria as well as the preliminary findings of the current research are presented.

OVERVIEW OF SOFTWARE INDUSTRY IN NIGERIA: COMPANY PROFILE

The survey – using questionnaire plus interview follow-ups – was conducted to cover the whole of Nigeria. The software companies are located mostly in the southern part of Nigeria. The clustered location of software industry is in line with other countries but for reasons accrued to the higher literacy level in the southern part of Nigeria. For example, low level of literacy and education is predominantly Islam-based where indigenes are encouraged from early childhood to go to Islamic or Arabic schools as against the western education (Soriyan *et. al.*, 2000). Even the few that were admitted to the universities end up with courses that enhance their religion and political strengths.

Only those companies that develop, modify and/or implement software were included in the analysis. The software industry appeared to be unevenly distributed by state, with just 14 out of the 36 states plus the Federal

Capital Territory (Abuja) registering the presence of a software firm. See Table 1. The cities that had higher percentages of the software industry were the commercial cities not necessarily with better infrastructure than in other parts of the country rather human resources were available and the possibility of clientele higher.

Table 1: Software Company Distribution by Zone and by State in Nigeria

Geographic Zone	State	No. Firms	State Percentage	Zone Percentage
South East zone	Imo	1	1%	1%
South South zone	Cross River	2	2%	
	Delta	4	4%	
	Edo	11	11%	
	Rivers	5	5%	22%
South West zone	Lagos	52	49%	
	Osun	1	1%	
	Oyo	7	7%	57%
North Central zone	FCT/Abuja	4	4%	
	Benue	3	3%	
	Kogi	1	1%	
	Kwara	3	3%	11%
North West zone	Kaduna	3	3%	
	Kano	6	6%	9%
Total	***14 states***	***103***	***100%***	***100%***

The software industry population could not be predetermined because there was no prior empirical data but a total of 103 firms were identified by the survey[10]. Of these firms, two-thirds were only involved in IT activities, while one-third were involved in multiple business sectors including IT: a reflection, perhaps, of a lack of true specialisation in software among firms in the sector (Soriyan and Heeks, forthcoming). On the basis of the survey, we estimate the actual total number of active software firms in Nigeria to be between 130 and 150.

The software companies were mostly small in size: a typical software company has 11-50 staff of which 1-5 are IT professionals. Very few of the companies had more than 50 IT professionals: such companies had more than one branch and were often involved in business activities other than software development. On average, 1-20% of staff was female while 10% of firms employed no women. See Soriyan, 2004 for details

Software companies' growth is on the increase, unfortunately there is no corresponding increase in the required professionals. The software companies are mostly small in size with varied development focus but mostly private sector comprising of wholesale and retail trade (transportation, financial services, IT and other business services).

Software companies whose main line of trade was solely IT constitute 67% while those who had multiple business sectors including IT were 33%. The industry offer products and services mainly to the private sector of the economy of which 75% were indigenous customers, and the remaining 25% were foreign although mostly resident in Nigeria. The products were application packages predominantly for Payroll, Accounting, and Human Resources. 70% of the companies offer services that support foreign packages e.g. installation, or modification to local requirements. Allocation of staff time to software services is influenced by company's focus area.

OVERVIEW OF SOFTWARE INDUSTRY IN NIGERIA: PROFESSIONALS

The average age of the professionals was between the age brackets 20 and 29 years. The educational qualification of the IT professionals showed a combination of university degree or equivalent plus professional

[10] Where a company had more than one branch, it was only counted once via its head office.

degrees, an indication that the current university degree alone is not sufficient for professional practice in software development activities. The overall educational level of the professionals was higher than Secondary School level (High school level), although 84% of the companies had no professional with PhD degree in the establishment (see Figure 2).

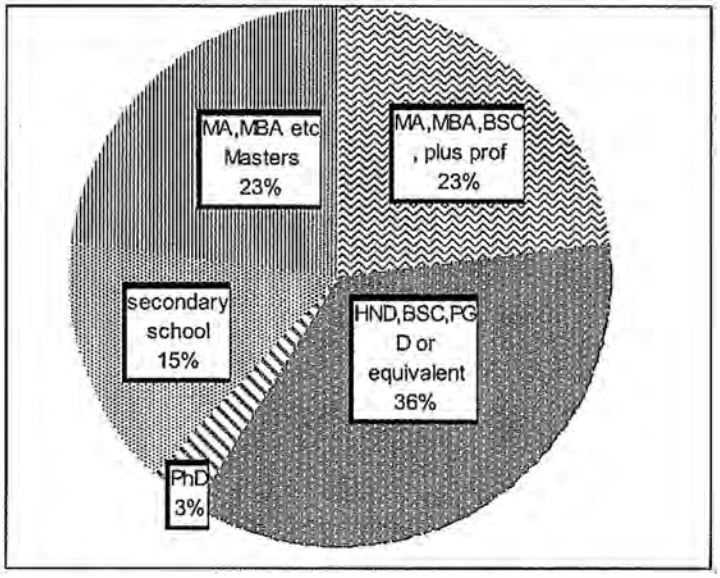

Figure 2: Educational background of IT professionals

The percentage of staff in each job category in the software companies was as presented in Table 2.[11] As can be seen from the modal category, a typical software firm had from one to five personnel in each of the five job categories. The average work experience of IT professionals was one to five years; few companies said they had staff with less than one year's experience. The respondents were asked to identify the predominant activities and estimate how much staff time was allocated to the activities. The result is as given in Table 3 below.

Table 2: Distribution of Job Designations in Nigerian Software Companies

	Valid Percentage in Software Companies					**Other Categories**
	Data entry clerk	**Engineer or Technician**	**Programmer**	**System Analyst or Designer**	**Manager or Project manager**	
No response	41	10	19	13	9	64
1 – 5	42	60	56	70	79	20
6 – 15	11	19	18	13	12	11
16 – 50	7	12	6	4	0	3
51 – 100	0	1	0	2	0	2
Valid Total	**60**	**92**	**80**	**89**	**91**	**36**

[11] 'Other Categories' includes jobs like marketers, instructors or trainers, package implementers, and consultants.

Table 3: Staff Time Spent on Particular Activities in Nigerian Software Companies

Activities	Staff Time Spent	Explanation
Training and education	21%	Computer appreciation classes, data processing training, specific software packages (often they were not developed by the firm concerned but were imported "standards", in some cases, companies did not own copies of the software) training.
Software systems installation	18%	Loading and setting parameters of packages (mostly imported) to the customer's needs.
Long-term support to installed sites	17%	Providing technical or user support when customers ran into difficulties. Such services were provided for both locally-developed and imported packages.
Package development	16%	Development of software products.
Tailoring/Customisation	11%	Tailoring-reload or update systems and applications for specific organisational needs while customisation involves the modification of a non-conforming product (if locally-developed) or its modifiable components (such as reports, tables, interfaces, etc for an imported product) to try to meet those requirements.
Consulting	10%	Include a wide variety of activities such as software project management, support, software development, software system acquisition and integration, and business process reengineering
Marketing	7%	Active promotion of goods and services.

SOFTWARE DEVELOPMENT EDUCATION IN NIGERIAN UNIVERSITIES

The last few years witnessed significant advancements in the state of computer science education (and in allied fields such as computer engineering and information systems) with evidence of many private universities being established. Before the proliferation of private universities, existing 24 universities were government financed, had full authority each university developed curriculum that best suited their goals.

There were existing Computer Centres established to centrally provide computing facilities for the university needs and the Department of Computer Science in particular. Many of the universities produced indigenous software packages for the universities' long term use, e.g. Payroll for the university salary section, Expenditure control, and Students' Records among others.

The computer installations in the Nigerian universities up till early 1980 were planned and managed by ad-hoc computer trained personnel. Graduates of Computer Science at about 1976 were supervised by the non-professionals. Even Computer Association of Nigeria (COAN) (now Computer Society of Nigeria, CSN) was mainly managed by the non-professionals (e.g. Sales men, Marketers and enthusiast etc) until recently when participation of Computer Scientist increased. The situation continue to change, the demands for professionally qualified individuals that can develop a full blown software packages for different environments is also on the increase. Hence more universities now have established Departments of Computer Science to produce manpower to meet the needs.

However, none of the universities has adequate number of academic staff except one, out of the 26 universities offering Computer science, had the required number of Assistant Lecturers (those with Master degrees) and the particular university only offer a certificate course in Computer Science. In some of the universities, lecturers from other universities are hired on short term basis to fill the gap.

Staff development scheme was established in the universities to train staff in new techniques and methods in the different fields but the non-availability of funds has been a major problem for effectively running the

programme. Apart from this scheme, higher percentage of the lecturers acquire new techniques and methods from the Web, literature, practical work, and by attending lectures organised by professional bodies.

None of the institutions has adequate laboratory and computing facilities for the student population, in fact some universities that participated in the project does not have any laboratory or computers for software development courses. None of the universities had up to 50% of the required hardware and software tools and almost all do not have a software engineering laboratory.

SOFTWARE DEVELOPMENT PRACTICE AND EDUCATION ASSESSMENT BY THE INDUSTRY

Software industry development practice assessment showed a need for improvement. In general, installation at customers' site, user training and education, Programming, and customer involvement show no major difference from what obtains in the software development process cycle in developed countries. Those practices with a higher need for improvement in the industry includes Risk analysis management and sustainability, Project planning and management, Requirement Analysis, Technical design, Documentation, Testing, Assessing impact of IS, Long-term support, and Database design, which are the processes at the early and late stages of the development process cycle. The summary is as presented in Table 3.

University software training programme was also assessed from the industry perspective of the professional (university graduate) work output. This is achieved using the contribution of the newly employed university graduates to the companies where they work. Quite a high percentage of the companies identified the need for 'much improvement' in all the development tasks assigned to the newly employed university IT graduates. Only very few of the university software education contribute to the companies' development according to the companies' assessment.

Table 3: Practitioner assessment of Software development education and Practice

	Much to improve		**In good order**	
	University Training	**Industry Practice**	**University Training**	**Industry Practice**
Project planning management	56.4	27.6	3.8	22.4
Risk planning & management	67.5	23.7	5.2	14.5
Customer relations, user involvement	45.3	13.2	5.3	40.8
Requirement analysis	45.7	11.0	6.2	31.5
Technical (architectural) design	45.1	15.4	7.3	33.3
Database design	47.0	21.3	6.0	37.3
Programming	56.5	14.5	8.2	46.1
Documentation	43.9	20.8	7.3	32.5
Testing	41.0	14.3	3.8	32.5
Installing systems at customer sites	32.9	10.4	15.8	54.5
User training and education	30.4	7.8	16.5	49.4
Long-term support to installed sites	36.0	8.9	9.3	32.9
Assessing impact of IS	41.9	20.5	6.8	27.4
Others (research, pioneering breakthroughs) ..*Industry*	33.3	29.4	13.3	58.8

The assessment of the 14 activities in both the software industry and university education were subjected to factor analysis, result is presented in Table 4 and 5 respectively. The result shows strong association with some variables. Each group is named following the common characteristics within the group.

Table 4: Rotated Component Matrix of Industry Practice

System Development Activities	Developm ent-core activities	Functional Specification &	Late development
Programming	,807		
Database design	,778		
Documentation	,756		
Testing	,567		
Assessing impact of	,482		
Project planning		,741	
Technical		,678	
Requirement		,673	
Customer relations,		,631	
Risk planning &		,617	
User training and			,867
Installing systems			,767
Long-term support			,741

These results present quite a mixed picture but there is some justification in drawing a conclusion that the relatively more technical and lower-skilled tasks – programming, installation, training – are seen as relatively less problematic. By contrast the more managerial and higher-skilled tasks – such as risk analysis and project planning and management – are seen as relatively more problematic. This then presents problems for those firms seeking to break away from simply providing limited value-added services for imported packages. (Soriyan and Heeks, forthcoming).

Table 5: Rotated Component Matrix of University education

Software Development Activity Education	Software Project Management & Testing education	Implementation & Maintenance education	Core development Education	Software Customer- relation education
Testing	,710			
Others (R &D, teaching of irrelevant SW)	,679			
Documentation	,638			
Project planning &Management	,598			
Risk analysis & Management, Sustainability planning	,512			
User training & Education		,868		
Installation at customers' site		,748		
Long-term support		,689		
Database Design			,851	
Programming			,819	
Technical (Architectural) design			,555	
Requirement Analysis				,819
Customer relations, User involvement				,543
Assessing IS impact				,540

Strategic Positioning Of Software Industry In Nigeria

In building up the software industry a number of choices should be made ranging from the software products, services to offer, target customers, and the available market. The Nigerian software industry should explore the local and international markets but might start from the local market as proposed by Heeks (1999). The industry must also be innovative to survive the competition with others in the unprotected environment. This requires distinct capabilities and competitive positioning (Traill and Pitts 1998). Otherwise, it will 'stuck in the middle' with no action opportunities (Porter, 1995; Borch, 1999; Heeks 1999).

Heeks (1999) presented five strategic positions occupied by the software industry in developing countries, using India as a case example. See figure 3. The quadrants, 'A' occupied by countries who export software services to foreign countries, 'B' exports software packages, 'D' those that service the domestic markets, 'C' those that produce packages for domestic consumption, and 'E' takes a little of each of the quadrant positions. He characterised India as an "export enclave" for software services in which skills and technology fail to trickle down into the domestic market. He emphasises the need for the companies to engage in local software package development, at least initially. He expresses the fear that much is not gained in the outsourcing to developing countries, as software professionals in these countries are paid much less, yet a lot of investment goes into purchase of materials from developed countries thus 'eating' deep into the financial strength of the developing countries. More still, the customers have doubts about the products from the developing countries. Those developing countries are patronised because of the cheap and talented programming skills offered.

In the figure, position C, termed the "Third World Microsoft," is presented as the best for the industry although the entry barriers are so high that the industry is presently not active in the strategic position.

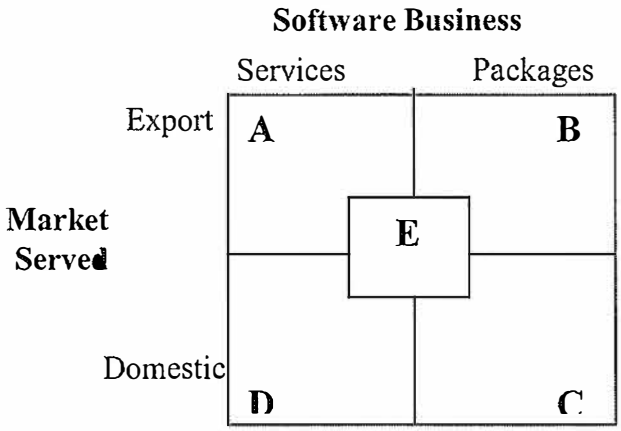

Figure 3: Strategic position for developing country software enterprise

The Nigerian case gives a different picture from the Indian example. The software market in Nigeria is mostly local with few companies planning to explore exportation of products to countries with similar development and social environments.

Foreign software packages predominate in Nigeria, and the software industry provide services including modification of the packages to local requirements, installation, configuration, and maintenance. The industry also provides other work activity, including software tailoring and package development. Customisation, however, is more popular than software packaging. The Nigerian industry position is located within the domestic market, but its activities include aspects of both services and package development. The software development activity varied from Bespoke, Tailoring, to Configurable packages; hence the Nigerian position is more a hybrid of strategies represented by the egg-shaped objects in Figure 4. This hybrid position appears to be the most stable and successful in the Nigerian case.

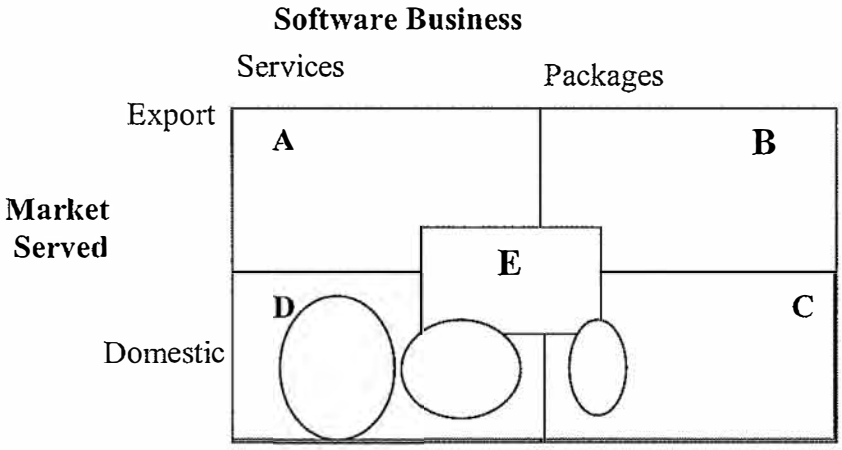

Figure 4: Nigerian industry strategic position within Heeks model

Therefore a more realistic strategic position that addresses the following factors:

1. Location of industry clustered around Southwest
2. Good knowledge of market needs (application area weak)
3. Line of business (sector-oriented and localised, essentially focused on the public sector and accounting package)

4. Skilled personnel (unstable)

5. Advertisement method (mainly by personal connections: "who you know"; this approach will not be applicable for outsourcing)

6. Foreign package dominance

7. Services offered (mainly to support foreign packages)

8. IT policy (ineffectively implemented and over-ambitious).

Figure 5 presents a more realistic strategic position for the Nigerian software industry. The position D_{1a}, D_{1b}, D_{2a}, D_{3a}, D_{3b}, are the position D in Heeks' model but broken into different software activities in Nigeria, while the positions C_{1a}, C_{1b}, C_{2a}, C_{2b} are the position C.

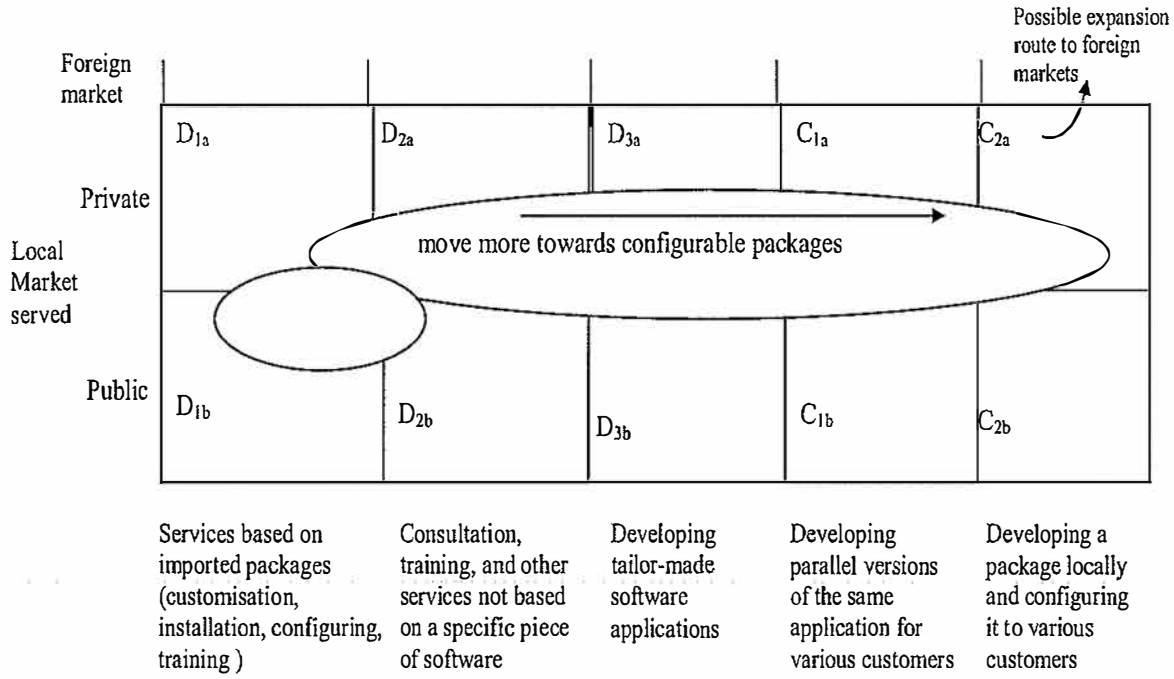

Figure 5: The proposed strategic position for the Nigerian software industry

The strength of each position increases from left to the right, D_{1a}, and D_{1b} are the weakest for professional software practice which threatens the domestic economy by promoting importation of foreign products which often lacks local content. D_{3a}, D_{3b}, C_{1a}, C_{1b}, C_{2a}, and C_{2b} are, however, positions of opportunities and strengths.

BUILDING THE BRIDGE BETWEEN PRACTICE AND THEORY

Much as it is believed that the proposed strategy for the Nigerian software industry will improve the development practice, a major input is the education of the personnel which need to be improved to make any impact on the industry, as reported from the just concluded study (See Table 3.). The main goal of the research reported in this paper is to reduce or close the gap between the industry and the University software development education. The current research has two main objectives; the first is to enhance the Made In Nigeria Primary Health care and Hospital Information System (MINPHIS), by developing the Primary Health Care component of the package (reported in another paper to this conference), and the other is to enhance software development education in Nigerian Universities.

The Software development education project in Nigerian universities is set for a pilot site, students from Computer Science and Engineering department, Obafemi Awolowo University as the 'test case' and three Software Companies has also indicated their willingness to participate in the research. The research is collaborative in nature and two main targets are chosen to address the problem.

Building Bridges Between Practice And Theory : The Need

One of the outcomes of INDEHELA-M research was the poor performance of the Computer Science Graduates that are newly employed in various software development companies (see table 3). Many of the tools available for training are obsolete, and in some cases not even available (Soriyan 2004). The research also reported the poor performance in key software development projects of fresh graduates. Some core activities were rated poorly handled or needed immediate attention e.g. database design, requirement analysis, software technical design, testing, documentation, project planning and management, risk analysis and management among others. This therefore does not make the graduates from the University, a major resource, suitable for the industry until they are re-trained. There is also the problem of inadequate or obsolete tools in the Universities yet the subvention is decreasing almost on a constant basis.

Building Bridges Between Practice And Theory: Method

Two approaches will be used in addressing the problems identified above. The first is involving the professionals from the industry to share specific field experience on a real-life software development project with prospective software professionals from the universities. The experience will focus on three identified problem areas in software development training courses identified in the earlier project (Table 3). These are: (1) Database Management System, (2) Software Engineering, and (3) System Analysis and Design are used as pilot courses.

Student offering these courses are the target. The number of contact hours is as determined by the university, but the professional will take a maximum of 30% of the contact hours. Lecture delivery mode could be online or face-to-face. The Obafemi Awolowo network facilities will be used in case of online mode.

Both the lecturers and the practitioners will examine the students' performance at the end of the course. The course syllabus and objectives are made available to both the student and the professionals. Assessment of the project will be carried out by all stakeholders. The students will assess the mode of teaching, the knowledge acquired and the relevance to their training.

The second approach is the joint supervision of real-life software projects. The project will be suggested by the participating companies. The company will state the areas of need, and also the development platform. The department will select the students to participate, and will also facilitate the project. The set of students who start the project may not necessarily complete it, but they could be hired to complete it. Other students will continue from where the pioneer group stopped. Except the companies so desire, the tools will be as defined at the beginning of the project and will:

1. Suggest their areas of interest, and if possible the topics

2. How many of the students can be accommodated on the software development project?

3. The desired outcome from the project

4. The development platform and tools.

Other universities have been contacted and the response has been quite positive. It is hoped that the same will be repeated in other universities and possibility of the students participating in same projects will be explored.

Building Bridges Between Practice And Theory: Logistics

An affordable hotels for a specified number of weeks will be arranged by the research team on the recommendation of the companies and transport allowance will be paid to the students alternatively, stipend will be paid. Three laboratories, Software Engineering, Health Informatics, and *NACOSS 1984 located at the Computer Science and Engineering department will be used for the development projects when the students are

* Nigerian Association of Computer Science Students

on campus. Some identified development tools will be purchased for the laboratory if they are not available. The companies are expected to make some of the tools available in the department.

Building Bridges Between Practice And Theory: Benefits And Expectation

Students will learn new techniques and tools, while the industry will be better served, as they get seasoned professionals to work on projects. Possibilities are that some areas of software development in the university can be jointly developed with the participating companies, and some of the software products from the university can be packaged better for Marketing. The students will also learn more about software development standards.

The desire is that the future of software development in Nigeria be improved and within a couple of years the industry will be transformed so much that they will have confidence in the University education. An evaluation by both the lecturers and the practitioners of the state of the students will be carried out just before project take-off. We will again repeat it at the end of the session. This will be used for future reference. The impact of the project in the software industry will be measured periodic assessment for about five to six years after participants' graduation.

PRELIMINARY FINDINGS: INITIAL INTERACTION WITH COMPANIES

Interaction with the industry indicated that a good number of these organisations are interested in active collaboration with the university and are ready to participate in moving the software industry forward. However, some are cautious in accepting the proposal based on the fear of been vulnerable as an organisation and wanted some issues to be clarified.

One of the respondents from the industry queried the rationale of exposing the students to 'proprietary knowhow' and 'a number of these students will end up floating into various competing organisations, often taking along their proprietary knowhow'. Issues of exposing the students (and perhaps teachers) to detailed information that is considered 'highly confidential' by the organisation without adverse effect to the organisation strategies and exposing it to competitors need to be sorted out before take off.

Another company's concern is about 'Data security' especially of clients in sensitive organiosations e.g. a banking sector. Organisational structure of such clients does not recognise industrial attaché or according to the respondent 'at the moment, I run the IT shop of a bank and we do not have space for industrial training'.

Another company wholeheartedly welcomes the idea and is willing to be fully involved in the two approaches. He said there are tasks for them because the company ' has some exciting assignments in mission critical application development.....also a project to create a commercial Workflow engine and JDBC. All our applications are optimised with ORACLE, Sybase and SQL Server RDBMS on the Window 2000 Server and ISS WEB server.

It should be noted that most of these tools are not available in most universities in Nigeria.

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Gandhi's Third Assassination: ICT Education in India

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ABSTRACT

The impact that information technology can have on development is the subject of an ongoing debate. Central to this debate is the role of universities. Education shapes people's attitudes towards technology and determines how it will be used. This research shows that in India, students at higher educational institutions are socialised to believe that information technology can have a very positive impact on their country. They do not share the scepticism commonly found in Western literature. This research finds that there is a strong belief that India is on the rise, and ICT is one of the major catalysts. Students believe that it is their destiny to make India a great world power. These attitudes are perpetuated and institutionalised partly through the higher education system, which shapes the way technology is seen. First and foremost, IT is seen as a tool for personal development, where students can leverage their education to become rich and successful, either in India or abroad. Secondly, IT is seen as a tool for Indian ascension, which will lift it to the status of a great global power. Only thirdly, IT is seen as a means to assist in the development of India's poor population.

INTRODUCTION

Often, great revolutions precipitate major changes in education. During the Industrial Revolution, education was carefully calibrated to meet the needs of the "new economy". Sustained emphasis was put on cleanliness, punctuality, obedience – in other words, the requirements of industry (Moll 1998). Today, at the dawn of the Information Age, many commentators are asking for another entire restructuring of the education system, but what sort of properties should it embody?

Some writers such as Manuel Castells believe that IT has brought about fundamental changes to the world, and the only way to participate in the Information Age is "to be able to assimilate and process complex information". According to Castells (2001), if people are not able to acquire media literacies, social problems such as poverty and alienation will worsen. Amartya Sen (1999) has changed the way we think about development by focusing on human capabilities; for him, the acquisition of these capabilities – such as media literacy – are a fundamental right. These thinkers argue that human capability and media literacies should be the cornerstones of the new education system.

But other authors take a more pragmatic approach. They argue that education meets the needs of the students when it meets the needs of industry (Kohli and Health 2001, Liu and Jiang 2001, Roberts 2000). This is not a perfect dichotomy because these authors acknowledge that industry requires workers who can think critically and have entrepreneurial zeal. However, it is worth noting that these authors are trying to shift the emphasis more *towards* industry, where the subtext in the writings of Castells and Sen suggests that the emphasis needs to move *away* from industry.

Some might say that this distinction is not so important. After all, if we educate people in order to get a job, surely they will acquire media literacy, and if we teach them media literacies, we are helping them get a job. However, there is a very fundamental distinction. Tailoring education to the needs of industry strengthens the existing order. Tailoring education to human capability enhances the possibility for more appropriate change, taking into account the local context and local needs. This distinction becomes even more important in the context of developing countries and is centrally related to the theme of this conference: *enhancing human resource development thought ICT.*

If ICTs are to have a positive impact in this regard, one crucial aspect is the sociology of education. Education not only imparts skills, but it also shapes attitudes, values and behaviours. This study looks at higher ICT-

education in India and examines how it shapes the perception of ICTs and how they are to be used. These perceptions are crucial in assessing the potential impact that ICTs can have on human resource development.

LITERATURE REVIEW

The growth of information technology in the West has prompted many to suggest that the positive benefits that have accrued from ICTs can also be achieved in developing countries. Some argue that ICTs can make societies healthier, wealthier and more democratic (Abbott 2001, Mbarika 2002, Netcheva 2002). Eggleston et. Al. (2002) refer to ICT as "the gift that keeps on giving." These writers espouse a particular technologically deterministic view, where the world is the "effect" and technology is the "cause".

However, this simplistic view does not necessarily reflect reality. There are many instances of an ICT implementation that did not meet its original objectives because of social factors (Madon 1993). In light of this, many authors have taken a second look at the relationship between ICT and development and have concluded that the success of ICT initiatives is more dependent on context than technology. In looking at Asian success stories, Bhatnagar (2000) concluded that success stems from real local ownership and "the courage to face the challenge with vigour."

Mixed within the differing view on what makes an IT initiative a success is a lurking scepticism about the whole endeavour, not just of the application of information technology but of development itself. Escobar (1995) is sceptical of the unquestioned assumption that by planning and applying technology, change can be promoted in developing countries. Avgerou (1998) argues that the West often perceives problems in developing countries, based on their own rationalities, which stem from their own histories. In this light, the Western idea that Western technology can be used to solve the problems of developing countries looks disingenuous – not just because of the biased perspective, but also because of undeniable differences in context.

Finally, Erran Carmel (1997) pointed out that the rise of information technology in America is not simply a matter of the technology being developed in America. The cultural traits, the motives of the US government and the legal infrastructure have all factored into the growth of ICTs. In contrast, governments of developing countries often have paternalistic governments that are exclusive and not production-oriented (Avgerou 1990). These cultural differences fuel the doubts of many about the role of ICT in developing countries.

Despite the well-justified scepticism, there is the prevailing view that developing countries have no choice. Nobody is seriously suggesting that countries ignore information technology. According to Castells (1996), the world today is more connected than it ever has been. In the new "information society", the success of developing countries depends on their information literacy and their ability to handle information and that in turn depends on education.

The ability to move into the Information Age depends on the capacity of the whole society to be educated, and to be able to assimilate and process complex information. This starts with the education system, from the bottom up, from the primary school to the university. And it relates, as well, to the overall process of cultural development, including the level of functional literacy, the content of the media, and the diffusion of information within the population as a whole (Castells 1999).

Castells does not clearly explain what he means by 'cultural development' but he seems to imply that it is the establishment, through the process of education, of certain attitudes, values and behaviours. For many authors, this is the primary purpose of education (Mitch 1999), the process referred to as the sociology of education. The idea is not new, for the Roman Empire, conquering lands also meant civilising people and "saving the savages" (Spring 1998). This was often manifested in a form of cultural education (ibid.). And as mentioned, during the Industrial Revolution, the education system was transformed to shape attitudes and behaviours that were immediately needed by industry. Thus, from the early days, education was not only a way to teach people skills, but also as a method to spread and entrench a particular ideology. Today, education also serves that purpose as well, some go as far as to call it "brainwashing" (Angell 2000).

However, this approach puts education in a very negative light. When viewed in this way, one can get the feeling that education is merely a method of distributing propaganda. Some authors view the socializing aspects of education in a much more positive way. Mathur (1966) sees it as a tool to build civic duty and instil a sense of citizenship. In Singapore, the sociology of education is seen as a way of promoting economic development

(Spring 1998). According to Parelius and Parelius (1978), there are two major theories in the sociology of education that reflect these two views.

Consensus Theory – Consensus theorists believe that societies are like organisms with interdependent parts. The society flourishes when it is in a relatively stable state achieved through consensus. Emile Durkheim (1956), one of the leading proponents of consensus theory, argued that society needs to provide a "moral education" to pass on central beliefs from generation to generation. Talcott Parsons (1959) went further and suggested that education is not only used for socialization, but also for selection. He saw the classroom as a social system where students aim to fill moral and intellectual requirements, and are rewarded accordingly. These rewards determine which students attend universities and how students are allocated into professions. The salient point is that both Durkheim and Parsons saw the role of education as a method of establishing a stable, integrated society of well-functioning interdependent parts (Parelius and Parelius 1978).

Conflict Theory – Many authors feel that the consensus theorists have blinded themselves to the obvious hostility, violence and conflicting goals that exist in society. These conflict theorists see the world in a constant state of change. For them, education is a coercive tool used by the powerful to indoctrinate the oppressed and justify their rule. Samuel Bowles (1972) wrote that capitalism weakens the family and reduces its ability to socialize the young. Further, inequalities of wealth and oppressive factories create a threat to the interests of the elite. And so the ultimate solution is mass education, which supplies workers with appropriate skills, and more importantly "legitimizes existing inequalities in the social division of labour by suggesting that these inequalities are based on merit rather than on coercion (Parelius and Parelius 1978)."

The distinction between conflict and consensus theorists is central to this paper because one of the primary questions being asked is whether or not education strengthens the existing order, or creates the possibility for destabilizing change. This study examines that question by looking at the sociology of higher ICT-education in India. The methodology used was primarily semi-structured interviews with Indian academics, and document analysis to gain an understanding of the Indian context. 8 academics at 5 campuses were interviewed and the data was compared against the relevant literature and documents produced by the various universities. A discussion of the findings follows.

RESEARCH FINDINGS

It must be observed that while India is a very poor country, where 86% of the population live with less than $2 a day (World Bank 2002), it has a tremendously successful software export industry (Heeks and Nicholson 2002). In the literature on 'IT for development', India is often citied as a 'success story' (Bhatnagar 2000). This apparent paradox resonates through this study.

Upon Independence in 1947, India inherited an education system that was designed mainly to create administrative clerks that would support the British administration and not challenge authority (Chitnis 1993). The national government took over education policy and there was an explicit goal to use education to not only build the skill base but also to create a national identity (Mathur 1966). Rapid growth caused severe growing pains, and several debates emerged.

One major issue was 'equality of opportunity'. There has been a movement in India to increase the chances of people from previously disadvantaged groups to acquire a higher education. As in many countries, this has been met with much controversy, with the counter argument being that university admission should be based on merit. The issue of affirmative action is beyond the scope of this paper, but it is worth noting that in India there is a unique twist. There are cases where families from lower castes have risen economically and so their children have the both the advantage of a middle-class upbringing, and a lower-caste designation. There are enough of these cases that they have been given the name 'the creamy class'. The creamy class, while indicating that social mobility is possible, also raises a difficult question regarding admission quotas.

A related but separate issue is that of language. During colonial rule, there was an insistence that English was to be used as the medium of instruction in universities. Since it was the language of the colonizer, the goal of using local languages became "a nationalist cause and a pre-independence dream (Chitnis 1993)." However, at the time of independence, English remained the language of instruction due to the prevalence of existing teachers and teaching materials. It was also argued that English would better serve India in the long run through international links and greater access to knowledge (ibid). Today, ICT-education is almost exclusively conducted in English

which could be in contradiction with the ideal of equal opportunity. The child of parents who speak English, or can afford English schools, has a better chance of succeeding.

According to several respondents, students are somewhat isolated from these debates and focus primarily on their own personal development. Often, students will attend university classes during the day, studying a formal curriculum to gain general IT knowledge. In the evenings they will attend classes from what is considered a vocational institute, which teaches more specific skills that are in demand in the IT job market.

This education is costly and is typically only affordable to students of middle-class and upper-class backgrounds. Despite the high cost, families make tremendous sacrifices for students to attend premiere institutions, often selling land that has been in family possession for generations. Because of this sacrifice, there is pressure on students to find good jobs after graduation and repay their debt to their families. This contributes to the students' focus on their own personal development, and their own job prospects, rather than the need for some kind of national development, particularly of the very poor.

The underlying attitudes and perceptions of higher ICT Education are telling, and shape the attitude that students take on after being socialized in these institutions. A very clear and consistent sense of youthful confidence and optimism pervades the thinking about IT education in India. The optimism was present on many levels. Firstly, people seemed extremely confident about the potential of information technology to bring positive effects to India. This is understandable from professors of ICT and Management, but there was also a strong optimism from Development professors as well. Interviewees frequently mentioned the prevalence of telecommunication booths that have been set up in remote villages that allow very poor people to become connected. It was also observed that these booths are successful because people with very little disposable income are willing to pay for them.

Furthermore, there was a very real sense of confidence regarding the future of India itself. Many respondents were very serious in saying that, "India will lead the world". It was commonly assumed that students in India work harder than those in America and that the success of the American information revolution happened in part because of the ubiquity of Indian software engineers. Students are made to feel that they are an important cog in the Indian machine, and that IT is not merely a tool for their own development but also for Indian ascension.

Several respondents observed that India has a very young population, which is in sharp contrast to the aging population of the West. This statement is easily verified (US Census Bureau 2003). This distinction gives India an advantage, as the West will become increasingly dependent on youthful, intelligent, Indian minds. A related issue was that of the 'Brain Drain'. While this is a big issue in other countries, respondents reported that this was a dead issue in India. Educated Indians should move to where their skills are most needed. And if they do move elsewhere, India benefits because of remittances and through the contacts that India makes with the outside world.

On this note, respondents saw no merit in the argument that ICT was simply a vehicle for American culture, or a Trojan Horse. Respondents asserted that Indian culture is strong and does not need protection. Moreover, as one respondent reported, "Indians are driving information technology in America so we (Indians) are not the ones who should worry". A minority of respondents mentioned that sometimes there were failures in past IT projects, but there was a sense that now the education is much better and that during those earlier days, IT projects were often experiments. One respondent suggested implausibly that the resistance to IT might only last another two years.

It is worth noting that when discussing the benefits of ICT, most respondents focused on the benefits that could be available to the middle-class. According to them, the possible benefits of IT included the potential to start new businesses and to connect Indians to each other. There definitely seemed to be a sense that while ICT can be a tool to help the very poor, the more interesting applications were to be tailored towards the upper-middle classes, with the end goal of having India develop into a great global power.

It was reported that this focus on applications of ICT tailored to the middle-class is central to the students' thinking as well. Students were not really focused on the national development of India, or on the rural poor. They were more pre-occupied with their personal job prospects upon graduation. This is perhaps unsurprising, but it is worth noting that in the past, Indian education did have a more collectivist bent (Tharoor 2000). This is undoubtedly fostered by the high cost of higher education in India. When families make large sacrifices for their

children to go to university, there is pressure on the student to repay that debt. Often, success means 'making it' in the West.

Many respondents observed that the role models for many students were the Indian entrepreneurs who set up successful businesses in Western countries. This is reflected in the large number of books in university bookstores that are fawning biographies of the Indian 'heroes' of Silicon Valley (see Kshatriy 2003). This need not be the case. Indian students could be looking up to the individuals who have implemented information systems for India's rural poor. But in fact, it is the Silicon Valley entrepreneurs who take centre stage. This suggests that while Indian students are optimistic that ICT can be a tool for development, the really important point is that ICT can be a tool for their own personal development, and can help them get rich outside of India. According to most respondents, when these students 'make it' in the West, it is good for India and demonstrates its strength.

One final observation is that this research found a deep respect for rational thought, science and of metrics for management. This is manifested in the admissions procedures of standardized tests, the examination procedure as well as the message communicated from academics, particularly in the management disciplines where the positivistic forms of evaluation are deemed necessary in order to make the 'business case' for a particular IT initiative.

In short, it was found that higher IT education in India promotes a particular view of information technology:

- First and foremost, IT is seen as a tool that will enable students (as future IT workers) to become rich and successful, either in India or abroad.
- Secondly, IT is seen as a tool that together with other factors, will lift India to the status of a great power, which will eventually lead the world.
- Only thirdly, IT is seen as a developmental tool that can help the very poor.

In support of this view of IT, two other attitudes were found in the Indian context.

- First, a tremendous, unashamed, optimism regarding IT.
- Secondly, a reverence for rational thought and management by metrics, essentially modernist principles.

INTERPRETATIONS

Immediately, it is worth observing that these underlying attitudes stem primarily from consensus theory. There was no hint of class struggle. In fact, far from seeing ICT education as a tool for oppression, the findings of this research suggest that ICT is positioned as a tool for emancipation. This seems to be a taken-for-granted assumption and it is barely questioned. The idea that ICTs can have a positive impact seems to be institutionalised. When the respondents were asked what they think of the argument put forth by Peter Sy (2001), that the push to distribute ICT in developing countries was neo-colonial, interviewees would balk. Not only did they disagree with this argument, but they seemed to find it somewhat threatening. Naturally, colonialism has very negative connotations and the idea that India is on the rise is well-entrenched. The main catalyst for this rise, which is regarded as inevitable, is ICT. To suggest that a push for ICT is neo-colonial is anathema to the current India psyche. Thus, there is little support for Mansell's (2002) argument that ICT is a Trojan Horse that opens a door to negative influences.

Secondly, there is definitely respect, and even reverence, for modernism, science and rationalization. Indian education, through the admissions process, through the examinations, and through the curriculum is creating a belief in the students that metrics and measurement are of paramount importance. Thus, Indian ICT education, in effect, accepts the current world order, the rules laid down by the West and in particular, America. By looking at ICT in the same way as America, India is in effect strengthening the existing order, rather than creating an environment for destabilizing change. This strengthening of the world order creates an inertia which has important implications regarding the link between ICT and development. In the literature on ICT and development, there is a notion of 'appropriateness'. This is the idea that ICT should not be applied as a package, but rather its feasibility and desirability should be assessed within a given context. Central to this idea is the insistence that there is no such thing as 'best practice'. However, in India, according to many respondents, there *is* a belief that a best practice exists, and it is up to the intelligent, well-educated worker to find it, and use it.

The notion of appropriateness is particularly relevant to India, given its cultural diversity. However, there seems to be little initiative to examine cultural diversity and to find uses of ICT that are as yet undiscovered and locally appropriate. The focus is very outward looking and uses of ICT tend to be based on Western views of technology. In the current Indian context, the underlying attitudes perpetuated by higher ICT education run counter to current notions of development. These underlying attitudes make it difficult for India to identify locally appropriate uses for ICT, and the system, which nearly encourages graduates to seek success in the West, makes it difficult for India to develop indigenous knowledge systems (Madon 2000), and to create a real sense of local ownership (Bhatnagar 2000).

It may be easy to explain these findings as 'Americanisation' or the end of history (Fukuyama 1992). But a closer look at the Indian context suggests that India was particularly well suited for the modernist project. Firstly, for its own reasons, after independence, India consciously attempted to create a secular society (Lal 2003). This stemmed from the policies of Jawaharlal Nehru, India's first Prime Minister, who himself was decidedly agnostic, but it also was a useful way of building a country that was incredibly diverse and had a history of religious tension (Tharoor 2000). As John Gray (2003) wrote, secularism was one of the fundamental pillars of Modernism, and although India's secularism was quite different from the secularism of the West (Tharoor 2000), it still had the effect of reducing the importance of religion, and creating a fertile soil for the rise in stature of science and technology.

Secondly, the British left India with a system that was build for their own benefit but was also particularly well suited to modernist ideals. A tool of administration rather than governance, it was strict, procedure oriented, and highly rational (Chandra *et al.* 2002). Thirdly, India had long-standing traditions of work in science before and during the British administration (Raina 2003). This tradition of science and a healthy appetite for experimentation left India with an existing respect for one of the major pillars of modernism.

Finally, the Indian diaspora helped establish and perpetuate modernism in India. As the diaspora grew, it became a method of transfusion, for technology, ideas and money. Thus the modern project that was being undertaken in the West was easily transported to India, a country receptive to modernism for the reasons outlined above. As the diaspora grew in stature, it helped fuel the growth of India's ICT sector (see Heeks and Nicholson 2002). Indians at home became tremendously proud of their countrymen who made a success of themselves abroad (Kshatriy 2003). Thus, the Indian diaspora began to form a powerful and influential body within India itself, and it is reasonable to believe that they have been propagating their own agenda, perhaps unconsciously, of creating a reverence for ICT and ICT workers. This was barely resisted by Indians at home who were happy to make heroes out of their countrymen abroad. Thus, the Indian diaspora helped to establish and perpetuate a modernist agenda and a deep respect for science and technology, in particular, information technology. In time, these attitudes became taken-for-granted assumptions that are now propagated in the higher education system.

Other reasons why these attitudes and values are institutionalised in India have to do with recent changes in Indian society. In a series of essays, Vinay Lal (2003) controversially characterised India as a country in crisis. This traces back to the time of Indian independence. At the time, there was a great debate about whether India should be divided into two countries, one Hindu and one Muslim. The decision to form two states – which currently has implications in Kashmir – was opposed by Gandhi who saw it as a needless way of creating additional tension. Despite Gandhi's reduced political role, he became the archetypal Hindu, advocating peace, tranquillity and a communal attitude that supported dignity and emancipation for the poor, commonly known as 'scheduled' tribes and castes.

But there was a separate aspect of Gandhi's character that some found contemptuous. He was assassinated by Nathuram Godse, a Hindu nationalist, on the 31st of January, 1948. Godse said that he resented Gandhi's relentless emasculation of the Hindu people. Not only was Gandhi known for his peaceful nature, but also for his commitment to vegetarianism, his celibacy, his rejection of violence and his suspicion of science and rationalism. This attitude became pervasive in India and coloured the conflict between Hindus and Muslims over Kashmir. According to Lal, Hindus developed a perception that they were less manly; they were peaceful vegetarians, in contrast to meat-eating Muslim warriors.

Lal writes that Hindus became self-conscious and began to tacitly fight to counter this view that they secretly had about themselves, and that they thought outsiders held as well. This manifested itself in a tough stance towards aggression in Kashmir, and also in a renewed emphasis on science and rational thought. It culminated in the successful series of nuclear tests in May 1998. Each successful test was celebrated by Indians joyously as they

passed around gifts and danced through the streets. According to Lal, this was the second assassination of Gandhi. This interpretation of the Indian context is particularly interesting in light of the findings of this research.

The attitudes that are being perpetuated by higher ICT education in India – the deep reverence for science and technology, the focus on one's own personal development rather than the development of the poor, and the overt desire to build India into a world power – clearly run counter to Gandhian philosophy. According to some authors, this erosion of Gandhian thought has culminated in a rise in Hindu nationalism and magnified cleavages within society (Lal 2003, Tharoor 2000). One respondent suggested that ICT is often politicized, with some politicians hinting that since India is clearly more successful at ICT than Pakistan, it shows that Hindus are smarter than Muslims.

Thus while Indians consider Gandhi a national hero, the social and cultural trends within the country and the geopolitical situation have all chipped away at the foundations of his philosophy. What is left is nearly the opposite: a reverence for science, distinct individualism, and imperial Indian ambitions. If, as Vinay Lal wrote, the nuclear test of 1998 was Gandhi's second assassination, then perhaps the current sociology of education, particularly higher ICT education in India, is Mahatma Gandhi's third assassination.

CONCLUSIONS

The significance of this research rests on two points. Firstly, there is a marked contrast between the scepticism present in the literature on ICT and development, and the optimism present in Indian society. This might not be a new observation, but it is still worth noting in light of the "dotcom bust," and the recent cooling of the global economy. Indians have felt the effects of the economic downturn, yet they remain profoundly optimistic about information technology. On a related point, while in the Western world, post-modern thinking is becoming more common, in India modernist ideals are still respected, and are the basis for the management of the economy and of the society in general.

Secondly, India is encouraging its students to be successful in the West, and is happy to define success by Western measures. This likely strengthens the existing world order. However, at the same time, Indians openly admit that they are poised to take on the world and confidently believe in the destiny of their country as a major global power. This apparent conflict does not necessarily mean that India will be unsuccessful in its attempt to gain more geo-political strength. They may beat the West at their own game. But these two points are significant when we consider the link between ICT and development, particularly in regards to India. Future research on ICT and development in India should not ignore India's strong optimism regarding ICT, nor its geo-political aspirations.

Returning to the theme of this conference, the findings of this study suggest that higher education associates ICTs with personal development and Indian ascension. In this way, it both limits and enhances human resource development. By positioning ICTs in this way, higher education hinders its effectiveness as a *direct* weapon in reducing poverty. However, it helps the upper-middle class compete in the global economy by focusing on the development of human resources needed by the current global economy. The impact that ICTs can have on human resource development are shaped in part by underlying attitudes within society.

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Application of Information and Communication Technologies (ICT) in the Control of Scientific Literature in Africa: Status, Deficits and Human Resource Development Implications

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Abstract

Despite evidence of increasing presence of ICT in Africa's education and research front, the opportunities offered by ICT in controlling scientific literature have not been adequately harnessed. As a result, African science is often assessed on the basis of the holdings of international databases. This paper shows that a true assessment of African science cannot be reliably undertaken on the basis of international indexing services. It is posited in this paper that factors related to information explosion, social, economic and political considerations, among others, often limit the capacity of national databases from being as comprehensive of sources from other countries as they are of their host countries. The paper posits further that local indexing of African science is an imperative that must pursued in order to create a basis for assessing science in Africa. The paper identifies factors affecting electronic control of literature in Nigeria, some of which are related to inadequacy of human resources capacity. The significance of this paper lies in the expectation that it will stimulate action, specifically in the area of human resource development, towards harnessing the benefits of ICT for the purpose of indexing of local resources in Africa.

1.0 Introduction

The objective of this article is to show that the near absence of ICT applications in the control of scientific literature in Africa is largely responsible for the low visibility of scientific activities in Africa; and that the true position of science in African countries cannot be reliably established on the basis of the content of international databases. This understanding is crucial in stimulating activities in the design, implementation and evaluation of databases for holding African scientific information upon which basis Africa's science can be reliably evaluated.

The impact of information and communication technologies (ICT) on higher educational institutions (HEIs) in Africa is mainly cast in positive light, with hardly any, regarding the possible negative consequences. These assessments are based on the evidence of either investments on ICT by tertiary institutions management (Nwuke 2003); levels of knowledge of ICT among various categories of staff of the tertiary institutions; use of ICT in distance education (Peter, 2003), among others. Supported by evidence of increasing access to the *Internet* (Oyeyinka et al. 2003), decreasing cost of hardware and software and increasing penetration of the telecommunication services, there is undoubtedly the presence of ICT everywhere in African HEIs. Beebe (2003) has observed that African universities are exploiting the use of ICT to build capacity for teaching and research at an international standard in one or more academic areas crucial for their country's economic or social advancement, foster and reward research, develop management information system, and devise management training courses for their university managers.

It, however, appears that increasing investment in ICT and their increasing use in the HEIs, notwithstanding; the visibility of the African scholar does not seem to improve (Gaillard, 2000; Waast and Gaillard, 2002). There is sufficient reason to speculate that increasing availability and access to ICT may be ironically negatively correlated with the visibility of African scholarship. This is because the rate of penetration of ICT into the formal science circles in Africa in the recent years does not seem to be justified by the current low international rating of African scientists (Cetto, 2001; King 2004). This observation may not be as much of the negative impact of ICT directly, as it is a

problem associated with how they are used. One of such uses for which African scientists, their governments and institutions seem not to have harnessed ICT is in the control of scientific literature, and the opinion here is that this negligence is partly responsible for the continuous low visibility of African scholarship.

2.0 The Scorecard of African Scholarship

There is, in the recent time, an overwhelming evidence for the disparity in scientific output between the developing and already developed countries (Gibbs 1995; May, 1997; Goldemberg, 1998; Riddoch, 2000). Recent United Nations Educational, Scientific, and Cultural Organization (UNESCO) estimates indicated that, in 1997, the developed countries accounted for some 84 percent of the global investment in scientific research and development, had approximately 72 percent of the world researchers, and produced approximately 88 percent of all scientific and technical publications registered by the Science Citation Index (SCI) (UNESCO 2001). North America and Europe clearly dominate the number of scientific publications produced annually, with 36.6 percent and 37.5 percent, respectively, worldwide. These statistics notwithstanding, more than 80 percent of the world consists of developing countries, which encompass 24.1 percent of world's scientists and 5.3 percent of its research expenditure. However, these countries only show a participation of 2 percent in the indexed output of scientific information. On the basis of national statistics compiled by organizations such as UNESCO and the OECD, certain authors have emphasized the shortcomings of the research systems in developing countries and the shortage of available resources. Some of these authors have also matched socioeconomic conditions against the level of scientific development to conclude that science is yet at its earliest start (Dunn 1982; Eisemon 1991).

The supply capacity of scientific articles to the world chore by African countries seems to buttress the foregoing observations. Based on the indexing of international databases, Cetto (2001) has provided a breakdown of contributions to mainstream scientific publications, by regions or large countries (Table 1 below), showing that sub-Saharan Africa supplied only about 0.7 percent during the period, far less than India (1.9 percent) and China (2 percent). The high ratio of publications for GDP (29) might be taken to show that irrespective of the SSA's low standing in scientific production, her number of publications still outweighs its Gross Domestic Product (GDP), an indication of the struggle of the scientists to keep above board.

Table 1: Breakdown of contributions to mainstream scientific publications, by regions or large countries

Region or country	% Publications	Publications/ GDP*	Publications/ Population
Europe	37.5	165	424
CIS	3.7	125	76
Sub-Saharan Africa	0.7	29	-
North America	36.6	163	717
Latin America	1.8	21	22
Industrialized Asia	10.8	69	113
China	2.0	16	-
India	1.9	47	11
World	100.0	100.0	100.0

***Source*: (Cetto 2001). GDP = gross domestic product.**

On his own part, King (2004) has shown that, South Africa contributing 0.52 percent of the total world literature during 1993-1997, 0.5 percent during 1997-2001, and 0.29 percent and 0.31 percent of the global citations, and 0.15 percent and 0.21 percent of the top 1 percent highly cited publications during the same periods, was the only African country ranked in the scientific impact of nations as at 2004.

Access to local or regional information in Africa presents its own set of challenges, with most African journals publishing only irregularly, and much research remaining unpublished as "fugitive" or "gray" literature or otherwise unorganized in databases.

Several studies such as Waast and Gaillard (2002), Rossi (1992), Hassan (2001), among others, have reported on the poor status of science in Africa, emphasising, low priority given to research in the region. Obviously R&D have low priority in the budget of many African countries.

Table 2: Public expenditure for selected African countries (2001)

Country	Public education expenditure		Public expenditure by level, % of all events		
	As % of GNP	% total government expenditure	Preprimary and primary	Secondary	Tertiary
Burundi	4	18.3	42.7	36.7	17.1
Cameroon	-	16.9	-	86.8	13.2
Egypt	4.8	14.9	-	66.7	33.3
Gambia	4.9	21.2	48.9	31.6	12.9
Malawi	5.4	18.3	58.8	8.9	20.5
Morocco	5.3	24.9	34.6	48.8	16.5
Namibia	9.1	25.6	58.0	28.9	13.1
Senegal	3.7	33.1	34.2	42.5	23.2
S. Africa	7.6	22.0	43.5	29.5	14.3
Zambia	2.2	7.1	41.5	18.4	23.2

Source: Compiled from Human Development Indicators (2002)

Based on the experiences of the OECD countries, the World Bank has recommended that education budgets should be between 4 percent and 6 percent of the GDP of countries, and no African country has ever achieved this (see a compilation above on selected African countries based on UNDP's Human Development Report (2002). This low priority for education has consequences on the fact that journal and other primary literature sources are irregular, where they exist (Garfield, 1978), and suffer featuring low quality articles, and poor refereeing practices. Also, the scientific community is relatively very small in size (Eisemon, 1978; Gaillard, 1996). In terms of research infrastructure, Africa also rates very low, with laboratories that are hardly equipped with modern facilities.

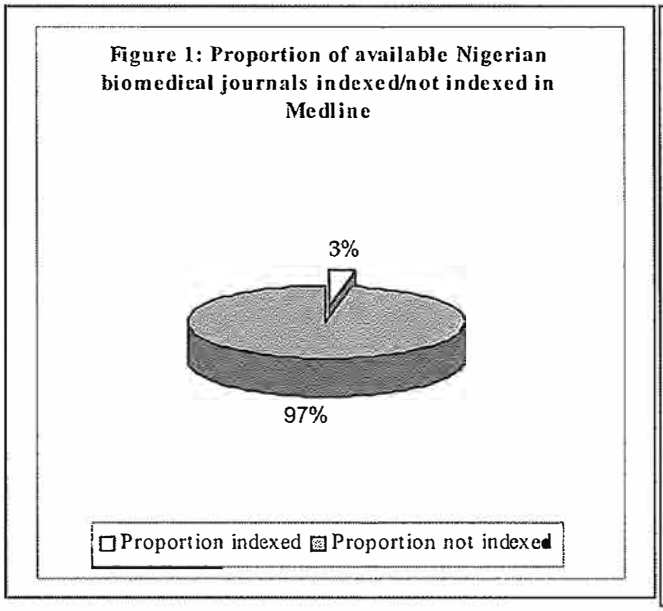
Despite evidence of fast *Internet* user growth in the region, Africa still constitutes only about 1.5 percent of the worlds 13 percent of users of the Internet, and has made only about 3 percent contribution of content to the Internet. ICT penetration is also lowest in Africa in comparison with other regions (*InternetWorldStats,* 2004).

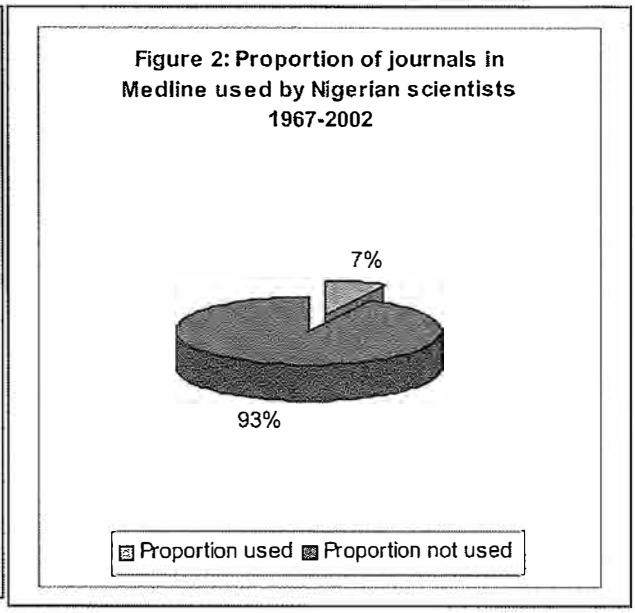
3.0 Who Indexes African Scientific Outputs?

The status of African scholarship is based on indexed output of scientific information (Lippman, 1994). A crucial question needs to be asked: Who indexes African scientific outputs? Most standard international databases, while important in their fields, have extremely low coverage of African research, and can be difficult or expensive to access. International databases are excellent sources of information for literature published in the scientifically refereed journals, but they are rather poor sources for location-specific national information, which is important for the African researcher. One can then ask, does there actually exist an objective scorecard of African scholarship based on existing international scientific indexes? The answer to this question is crucial because much of what is known about Africa is based on international indexes, which are normally selective of their developing region contents. But, crucial questions are, how visible are African scientists in absolute figure terms? For instance, what is the network size in the Physics community in Nigeria? What are the sources of influence in the biomedical research in Ghana? What is the contribution of non-biomedical scientists to biomedical literature on HIV/AIDS pandemic in Botswana? Answers to these questions do not exist, because what is known about African scholarship is based on the indexing services of the developed countries which is very selective of developing countries sources they include in their databases.

The inadequacy of knowledge about African science can be demonstrated with the indexing of *Medline* (of the National Library of Medicine, USA) on Nigeria. As at 1990, there were about 121 serials in the field of biomedicine in Nigeria, out of which *Medline* indexed only 4. As at December 2002, *Medline* retained these four journals as the only valid sources of biomedical literature on Nigeria. This number represented 0.13 percent of the over 3,000 serials

indexed in *Medline* and less than 2.5 percent of the whole journals circulating in Nigeria. In other words, when Nigerian science is assessed based on the listing in *Medline*, impressions are being developed about Nigerian biomedicine based on the content of only four Nigerian journals, and then on the publications on Nigeria that are contained in other than Nigerian sources. This disparity is shown in figures 1 and 2 below.





According to Lippman (1994), indexed biomedical articles related to Africa came from over 1,160 different periodicals, of which only 14 (about 1.2 percent) are from Africa, and of the 14, seven are from South Africa. He further elaborated that most African publications are not indexed anywhere, since the 1.2 percent of indexed African literature does not include the wealth of research papers, reports by ministries and NGOs, theses and dissertations from African medical schools, and other fugitive literature that is often of primary importance.

In agriculture, the situation is somewhat better because agriculture commands higher proportion of scientific concentration in most African countries (Dore 1996). The major international agricultural database citations of African research comprise 3.2 percent of the total number of records in AGRIS and 2.7 percent of those in CAB Abstracts. The 2.2 percent of African research citations in AGRICOLA, conversely, may therefore be considered unusually high, since that database is expressly focused on US research. Two databases, specifically related to tropical agriculture, have a high percentage of African citations by any measure: SESAME and TROPAG & RURAL, with African compositions of 39.7 and 17.5 percent, respectively. The proportion of records on Africa is also higher in databases maintained by the international agricultural research centers (IARCs) based in Africa, not only because of their location but also because their focus is on developing countries in the tropics (University of Pennsylvania, African Studies Centre, 1994).

Nobody disagrees that African scholarship is underrepresented in world science judged by the content of international databases. But nobody probably recognises that no database can do justice to science worldwide. There are possibly more than 45,000 journals in the world today (Moravcsik 1987). Since their inception in the 1960s, *Medline* has indexed more than 3,900 while ISI indexes more than 8,000 (King, 2004).

4. Databases: Purpose and exploitation

According to Moravcsik, databases are constructed for three purposes:

(i). To provide information on research already performed in order to support ongoing research. This arises from the fact that scientists want to build on what has been done and hence need to have information about them.

(ii). To provide information on the scientific community for the management of science. This information often forms the basis for the isolation of bibliometric indicators which are used to describe the outputs and other

measures of scientific activities in many countries, and hence they are useful for various functions of mapping of science, management and study of the evolution of science.

(iii). To provide information on the evolution of scientific knowledge and on the pursuit of science as a human activity.

None of the functions above requires that the database be complete of the publications in the world, neither can it be. Furthermore, none of these functions requires that the sources be ranked as qualitative or not qualitative. The requirement is that research is done and published in sources.

An extremely large database may not even be feasible due to the difficulty it poses to management. For instance, an often-mentioned constraining factor of indexing many sources is languages, which may not be in English. Although Institute for Scientific Information (ISI), for instance, indexes articles in 36 other languages (King 2004), it is expected that the languages of choice be finite in comparison with the number of languages that exist on earth and in which science is being published (Moravcsik, 1987). Although the basis for the exclusion of these journals may not be tied to language alone, it is extremely very costly to embark upon the translation of languages in order to index articles written in such languages. Moreover the users of this language may not be numerous to justify such an undertaking.

There are also factors associated with the nature of science itself. Scientists are likely to face problems that confront their environment, about which an international indexing service or source may have no significant interest. For instance, research in health and agriculture might focus on community-sensitive issues, which might not be internationally reckoned with (Winclawska, 1996). Furthermore, disciplines are culture sensitive. The role and nature of written knowledge are influenced by cultural situations in different environments, and this will constrain the universal indexing of science. Also, some global indicators might not be suitable for a fair assessment of scientific activities of certain researchers and countries. Furthermore, the idea of "mainstream journals" cannot be taken as credible bibliographic indicators for African countries' science. Also, most journals in developing countries are classified as non-mainstream, and therefore rank low in the index of quality. The significance of the foregoing points is that there might be a dissonance between research focus of the database in comparison with the local problems of different communities, and this might constrain scientists in selecting their sources. While journals, agencies and host institutions define their focus based on their perception of the problems at hand, scientists on their own side might define their problems based on the local needs of their environments, thus enforcing some divide between the journal and the scientists.

Politically, it is also neither possible to expect that national databases index all sources from all parts of the world. Databases play very significant roles in the positioning of scientists, their countries and institutions. Countries that have plenty of their local journals indexed in a database stand to appear more visible than those countries whose journals are few. Scientists whose local sources are less represented in database will definitely rate low in international indices. Hence, it appears that the most suitable strategy of electronic control of scientific literature would favour community approaches in which countries and regions base the assessment of their science on their national or regional databases. There is a parallel in the structure of regional economics, and, knowledge and development-based societies, which seem to provide theoretical basis for this emerging reality.

5.0 The Theses of the "Holy Trinity", the "Triple Helix" and the global pattern of literature control

In his study entitled *The Regional World*, Michael Storper (1997) argued that technology, organization, and territory could be considered as a 'holy trinity' for regional development. According to Storper, this trinity should not be studied as an aggregate of the composing elements, but in terms of the relations between and among these elements. These relationships shape regional economics. Storper formulated as follows:

> Regional economics, in particular, and integrated territorial economies in general, will be redefined here as stocks of relational assets. [...] Technology involves not just the tension between scale and variety, but that between the codifiability or non-codifiability of knowledge; its substantive domain is learning and becoming, not just diffusion and deployment. Organizations are knit together, their boundaries defined and changed, and their relations to each other accomplished not simply as input-output relations or linkages, but as untraded interdependencies subject to a high degree of reflexivity. Territorial economies are not only created, in a globalizing world economy, by proximity in input-output relations, but more so by proximity in the untraded or relational dimensions of organizations and technologies. Their principal assets—because scarce and slow to create and imitate—are no longer material, but relational. (Storper, 1997, p28)

The 'holy trinity' is to be understood not only as elements in a network, but as the result of the dynamics of these networks shaping new regions. These regions emerge as densities of relations that can be developed into a competitive advantage, when and where they materialize by being coupled to the ground in regions.

Although Storper's thesis was not focused on literature control, the thesis conforms to the observed structure of national literature control activities in the world today. It appears that, constrained by factors we have described, the pattern of scientific indexing follows the path of "holy trinity" in which a region or country gives priority to the outputs of its scientists based on technology, organization, and territory consciousness. That is, a country or region recognizes that its technology or its level of technology diffusion; its organizations and its territorial identity are intertwined. Hence, the scientific output of a country irrespective of its quality and standards are accepted as indicators of the level of development of researchers, research and science in the research institutions, and by implications, qualifies the territory. Countries that would want to posture their local research activities appropriately therefore develop their own databases and also develop own criteria to select articles that should be indexed in those databases.

On their own part, Etzkowitz and Leydesdorff (1997) have, in their Triple Helix theory, shown that the structure of the knowledge-based society can be visualized from the perspective of university, industry and government configuration. The university represents the scientific discoveries and all research activities that are expected to emanate from the academe. These discoveries are applied and developed independently by the industry under the control of the government. Today we find the roles of the university, industry and government intertwined in an inseparable manner, and these are expected to foster innovation, production and creation of wealth. The evolutionary interpretation of the Triple Helix model assumes that within specific local contexts, universities, government and industry are learning to encourage economic growth through the development of what Leydesdorff & Etzkowitz have called 'generative relationships', " a loosely coupled reciprocal relations and joint undertakings that persist over time and induce changes in the way agents come to conceive their environment and how to act in it" (Leydesdorff & Etzkowitz, 1997, p45).

What is the implication of these theories to literature control? Scientific literature represents a definitive evidence of what the university as an archetype of research and innovation institutions, is doing with the financial and other investments of both government and non-government agencies. In a sense, and with respect to the subject under discussion, both the 'Triple Helix' and the 'Holy Trinity' theses teach one lesson, namely a reliable understanding of the research activities that go on in any community can only be rationally based on the literature control services in that community. It is only in this way that the relationship among technology, territory and organization can be understood. It is only in this way that appropriate interrelationship among university; industry and government can be described.

The pattern of literature control globally seems to follow the observation that national databases focus on their local sources, and then apply some criteria to sieve out materials from other communities. This pattern supports the expectation that countries that have national databases will then probably rate higher in international reckoning. The corollary is also true. Those countries that do not have national databases will suffer the subjection of their national sources to quality and other standards criteria set by host countries of international databases.

Whatever are the conditions of science in any country, it is sufficient to consider the scientific outputs emanating from that country as an evidence of the country's science. Even when the question of quality is considered, whatever factors constitute shortcomings of publications from developing countries can become indices for monitoring the development of science. For instance, if journals are considered irregular, as it actually is in many developing countries, a crucial question that could guide action in improving science could be 'how irregular are the publications'? This strategy will help Africa monitor its science development.

The point being made here is beginning to manifest in global ranking of scientific output. In the recent years, a cursory observation is that countries, which have national databases, always base the assessment of their resources on the content of their databases, and this has tended to shift the visibility of scientists in different countries. For example, based on local indexes, Holmgren *et al.* (2004) have shown that Latin America and China, although representing, respectively, only 1.8 percent and 2 percent of scientific publications worldwide, have increased the number of their publications between 1990 and 1997 by 36 percent and 70 percent, respectively, which is a much higher percentage than the increments reached by Europe (10 percent) and industrial Asia (26 percent). The percentage of global scientific publications from North America actually decreased by 8 percent over the same period. This and many other studies that were based on national databases show that the statistics of publications of developing countries as often contained in the much older databases are actually misleading. It will be unacceptable today to read evaluations of China's, India's or South Africa's science based on a database that is located elsewhere because these countries have successfully organized their data resources. This fact highlights the need to encourage indexing at national levels in Africa.

6.0 The Imperatives for the Indexing of African Research

According to Layashi Yaker, United Nations Under-Secretary-General and Executive Secretary of the Economic Commission for Africa,

> *Africans are engaged in scientific research and writing and that they are trying to make their findings available to their fellow Africans and to the wider world as well. That is one part of the equation: the other is bringing to Africa this information as well as information produced from around the world so that African scholars, decision makers, and policymakers can make informed plans and recommendations for the future of this region. This is the vital foundation on which we can build our development efforts"* (Layashi 1994, p2).

Scientific data resources in Africa are hardly ever indexed in Africa. They are therefore unavailable and inaccessible. At the national and institutional levels, African leaders and scholars have not embraced such services as critical development infrastructure. As a result, science can hardly be regarded as organised. The absence of indexing of sub-Saharan African health and biomedical journals in the world's leading bibliographic information sources, is a common knowledge. This problem was recognized in 1990 as a major obstacle to the visibility of Africa scientists. Akhigbe considers this as a challenge to the African scientists.

> *The challenges faced by African researchers include under-representation in international databases, limited local publishing avenues (making indexing in databases difficult, whether local or international), and inaccessibility of databases (Akhigbe 1992 p12).*

The lack of databases of African science has led to several unfounded and sometimes baseless conclusions about scientific activities in Africa. For instance,

> *Index Medicus, which indexes more than 3000 journals worldwide, included four Nigerian serials...In contrast, a search of MEDLINE, using "Nigeria" in any of the fields, yielded 4613 citations. Thus, information on Nigeria is often published elsewhere (Akhigbe 1996 p22)*

This cannot be true. Abifarin's et. al. (1993) modification of this position seems to concur with our opinion in this paper.

> *It has been noted that the vast majority of information on Africa resides in databases in the North. Yet it would appear that very little of this information refers to actual African publications, i.e., research published within Africa. This distinction is important because of the implications for the cost and accessibility of the information for African researchers (Abifarin et al 1993 p45)*

Hence, although there might not be as much research activities going on in Africa as there are in developed countries, there is a clear evidence that more is being done than is reckoned with. Hence, we would rather suggest that much of the African research outputs that meet the standards of the Northern databases are often organized and indexed in the North, and therefore are available. Also, African research products that are available in the Northern databases are likely developed in Northern sources, or developed in Africa but published in sources outside Africa, or further still developed and published in those few African sources that are indexed by the Northern databases (Nwagwu 2004). Whichever the case, there is no suggestion that information on Africa is mainly published elsewhere. Rather, we would suggest that much of the African research outputs that are published locally are not indexed, and are therefore not accessible and available.

This position is supported by the fact that the publishing pattern of African countries' scholars shows that they focus mainly inwards. In Nigeria, this pattern has been observed. Shoyinka and de Cola (1984) carried out an analysis of publications at the University of Ibadan, and observed that the publication pattern of Nigerian scientists was mainly in local sources. Furthermore, Gaillard (1996) has observed that the publication pattern of African scholars is inward looking, and interpreted the result to be partly due to the consciousness in African scientists that their articles are not highly qualitative. How then can the top down indexing service of the North cover comprehensively the research activities of the scientists of the South? Crucially, the scientific articles of different countries should be considered as a definitive evidence of their science, and that such products require to be controlled as a basis for assessing and evaluating progress of science in those countries.

African scientists struggle to publish in mainstream journals in order to be cited in international sources. This quest could be counterproductive when the influence of publication channels on scientists is considered. For instance, journals define their areas of interest, and expect that scientists who wish to use the sources channel the problems they want to solve accordingly. A scientist who wishes to have an entry in any journals will therefore define his focus to address the focus of the journal; and this may be different from the issues that affect the scientist's immediate community. This could lead to disorientation between the community needs of a scholar and the problems the scholar is

often addressing. On the other hands, when scientists are satisfied with the sources around them, they most likely focus on the problems of their immediate environments (Palmer 1999). When the choice is between publishing in mainstream journals for the sake of visibility and solving local problems, common sense dictates that the local environment where the scholar owes his primary allegiance will inevitably take preeminence.

Hence, Africa needs to show evidence of the resources invested in research in different facets of its problems. For several decades, institutions in developed countries and development assistance agencies have supported the evolution of information infrastructures in developing countries. Except probably in South Africa, the idea of database of research outputs is still a very novel one. There is no consciousness about the extent to which an index of research activities in research institutions actually contribute to the empowerment of people, the accountability and responsibility of the institutions and scientists. The absence of indigenous initiative to collect, organise and index and link sources of scientific and technical information in the researches, and disseminate same to the various users, show that information is actually accorded limited status in Africa, and suggests further that its potential value is not yet self-evident. There is a need to widen awareness of what information, both published and unpublished, is available in Africa. Ignorance of previous research efforts may result in needless duplication and a wasting of precious resources.

Getting publications indexed in databases increases demand for the information, since database searching is the primary method by which references are located. Stimulating greater demand for African research is perhaps the single most important strategy for raising the profile of science in Africa and increasing its competitiveness and the flow of information both from and into the continent. With greater awareness can come opportunities for increased funding and vitality for the scientific enterprise and for its publishing arm.

The assessment of the development efforts in social, economic and political circles have relied mainly upon evidences of improved GDP of nations, improved living conditions, development of physical infrastructure facilities, among others. We need supplementary evidences from the primary scientific outputs of scientists and other stakeholders to gauge information with regards to who, what, where and when- about budgets and other forms of expenditure on scientific activities. But there is no systematic and empirical evidence as to the characteristics-content, sources, of the primary research basis for policy and development plans and programmes in most African countries. The challenge is therefore to identify meaningful parameters of indicators, qualitative or quantitative - based on complete coverage of scientific activities of Africa, local realities of science, and local quality criteria by which the overall research in the region can be assessed.

7.0 Factors Affecting Electronic Control of Scientific Literature in Africa

What major factors account for the lack of application of ICT in database services for literature in Africa?

(i). Perhaps, an over-emphasised shortcoming in the African development process is the low level of awareness about the role and use of information in national development, at the individual, community and national levels of in the society. At the policy-making levels, this observation is very striking. In his nationwide survey in 1982, Aiyepeku (1982) showed that public policy makers at the federal level in Nigeria did not have as high a level of information consciousness as they might. This factor affects database systems to the extent that awareness of the utility of information should be directly related to attitudes and awareness towards the technology that processes information.

(iii) At the policy making level, African leaders have consistently shown that they understand the implications of science and technology information in the development process. This can be attested to by the various OAU (now AU) declarations in this regard (Lagos, 1980; Kilimanjaro 1988; Addis Ababa, 1990). But there has not been any demonstrated will by any of the member states to implement the development of science and technology information.

(iv). Next is the problem associated with the structure of information policies in Africa, which focus mainly on ICT. Generalised and countervailing informatics policies rarely exist. The existing ICT policy approach seems to place ICT ahead of information, and can therefore answer the question: what can we do with information technology? But when information is rightly placed ahead of ICT, then the existing strategies can obviously not answer the question: what information problems can ICT be used for? While the first question implies that information technology experts are expected to have sufficient knowledge about the various aspects of the national life in which ICT can be employed, the second has implications that information workers and other professionals in different sectors can identify aspects of their activities where ICT can be applied.

(v). We can also identify low priority given to education for information in Africa, which manifests in low investments in education for information, low capacity and paucity of information professionals. According to Tiamiyu and Aiyepeku (2003), investment for information education in Africa is characterised by absence of programmes to train trainers, lack of development of institutional capacity for training trainers, and lack of funds for technical exchange programmes. As a result, there are no sufficient and appropriately trained information workers at all levels who could design, implement and evaluate electronic databases towards meeting Africa's growth and development needs.

(vi). There is the problem of non-current frameworks for the control of scientific literature in Africa. Although there exist moribund frameworks for literature control in many countries in Africa, for instance Nigeria, these frameworks were designed mainly when ICT were at their earliest development stages, and were therefore not ICT- compliant. This is in addition to the fact that the frameworks themselves were hardly ever implemented. There, seems therefore to exist a dissonance in the perceived role of ICT, and how these roles can be incorporated into the traditional ways of controlling scientific information.
(vii). There are other issues related to the unpopularity of information profession in Africa, ICT as strange to the culture of Africa and late consciousness of African countries about the role of ICT in development by African countries.

8.0 Implications for Human Resources Development

An examination of the factors listed above immediately shows that human resources development stands as a crucial consideration in addressing the problem of databases of scientific articles in Africa. Addressing this problem will require first that African countries review their volume and pattern of investment in information education. Information education is broadly used here to encompass the application of new technologies in traditional information professional areas. By investment in information education is meant, "*...foremost investments in programmes for building high level human and infrastructural capacities required to create the executive capacity for further investments in education for information in Africa*" (Tiamiyu and Aiyepeku 2003, p304). Those investments should include programmes to train trainers, to develop local institutional capacity for training trainers, and funding of technical aid and exchange programmes. There should also be selective investments in programmes for producing appropriate information workers in specialised areas, which are usually packaged in the forms of workshops, seminars, conference, and symposia, among others. We also join Tiamiyu and Aiyepeku to posit that education for information should be oriented more towards hard information, which is often required in decision making than generalised information, which is need by all persons in the society.

At the higher educational and research institutional level where, institutions that provide information education need to incorporate new technologies in their curricula to ensure that their information professionals acquire relevant knowledge to produce graduates who can be relevant to the requirements of the new environment. In this regard, information educators themselves also require to be retrained to assimilate new technology skills and to apply them in their teaching and research. Specifically, in the light of the fact that librarianship constitutes an overwhelming core of information professionals in Africa, the crucial suggestion of the revision of the curricula for librarianship to include ICT skills should be vigorously pursued.

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SESSION B5: RESEARCH PAPERS: THEORETICAL PERSPECTIVES

A Research Agenda for Research Projects in the Private Healthcare Sector of South Africa

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ABSTRACT

A research agenda is proposed to coordinate research projects within the private healthcare context of South Africa. These projects will specifically deal with data management and utilization of information by small medium size medical practices. This should enable them to benefit from computer-based information systems. Another aim of the research agenda is to address human resource needs to support both the research activities and private healthcare needs resulting from the research projects. Training is an important part of the delivery of sustainable appropriate information systems and involves the education of IT students to prepare them not only for a career in software development, but also to enable them to become researchers in the information systems field. Healthcare workers also need to be trained, as part of their professional development, to utilize patient data as an important information resource. All the research projects have to deal with many changes that the healthcare and education sectors are subjected to due to government interventions. This is also an attempt to close the gap between the public and private healthcare sectors' research efforts.

INTRODUCTION

Any research agenda today in South Africa should consider not only the complexities of the diverse population but also all the changes required to deal with the issues of the past. Although most sectors are subjected to external environmental changes and government interventions, the healthcare and education sectors are both currently part of major transformation processes. It would be feasible and justified to use ICT to facilitate healthcare delivery and management (Korpela, et al., 2004).

This paper proposes a research agenda, with double aims, that will in the first instance address some research issues that the private healthcare sector is subjected to. Secondly, will it address human resource needs to enable and support the research activities. The research agenda at this stage only includes topics addressing data quality, healthcare information systems and some training issues. The research activities, although concentrating mainly on private healthcare, are attempting to strengthen the relationship between the public and private healthcare sectors of South Africa. The current transformation in higher education and the merger of two higher education institutions, as well as government interventions in the healthcare sector, set the backdrop for the research activities.

The research agenda focuses initially on data management issues within the private healthcare sector in the Unicity of Cape Town metro municipality in South Africa. It is the start of extensive research activities and projects to eventually cover most of data management issues in the private healthcare sector and will span a number of years involving several researchers and other stakeholders. The research projects/topics proposed by the initial research agenda may seem disjoint, but the agenda is an attempt to coordinate the projects within the same research area that all have the same underlying research focus.

This paper first introduces the research issues that provide the context of topics of the research. This is followed by the agenda which is based on an organizational Information Management Model integrated with a research framework for information systems development. Such IS development, while taking place within the context of an organization, also considers the impact of individuals and society. In order to see the above in context, some background information is supplied.

BACKGROUND: Public and private healthcare in South Africa

During 2000 Lim and Tang stated that the healthcare sector is one of the fastest growing industries in the service sector and medical practitioners focusing on healthcare may therefore not be the best 'business' managers of these services. They indicated that the pressures that force change are, amongst others, the rising standards of living and education; advancement in medical breakthroughs; alternate healthcare mechanisms and increase of

information availability. The fast technology advances of ICT and an increased trend towards globalisation have an impact on all sectors. In South Africa the public and private healthcare sectors are also subjected to government interventions.

Public and Private Health

South Africa is rated by the World Bank as a middle-income country according to the Healthcare Sector Strategic Framework (1999-2004) which is in fact not reflecting a much more complex situation. About 20% of the population belongs to the private healthcare sector whilst the majority of the population have to rely on services provided by the under-resourced and over-used public sector. The private sector also attracts most of the country's health professionals with about 73% of all general practitioners treating less than 20% of the population. Public health consumes around 11% of the government's total budget. There is also a significant imbalance between rural and urban areas. The Strategic Framework 1999-2004 also states that in order to address the demands of the future, it is imperative that an information system is developed with the involvement of all stakeholders such as health districts, municipalities, provinces, private sector and national government.

The small-medium size medical practice (SMMP), an important part of private healthcare, forms the research object of this research agenda. It is being researched as an example of a business unit and the factors applicable for SMMEs (small-micro, medium sized enterprises) will be considered. A SMME within the private healthcare sector falls within the community, social and personal services sector that satisfies certain criteria of full-time paid employees, total turnover and total gross asset value (National small business act, 1996). Customers of SMMPs are patients and medical practitioners/doctors render a healthcare service to their patients. The two primary stakeholders of the SMMP for this research are the patient (customer) and the healthcare worker (service provider).

Health Landscape

The Western Cape has committed itself to an improved healthcare system and Healthcare 2010 was conceived in the face of two apparently irreconcilable objectives namely to balance the need to substantially improve the role of quality of care of health services within the constraints of expenditure within affordable and sustainable limits. The Western Cape, with 11 health districts, makes up almost 10% of the total South African population, with the majority (89%) living in urban areas as opposed to the national average of 54%. Less than 20% of Western Cape residents live in poverty. In order to study all the interactions of all the different stakeholders, it is necessary to develop a health landscape depicting all the stakeholders in terms of each other and the different sectors to which they belong. In addition to the public and private healthcare sectors there are also different levels in terms of the government's managing of the national healthcare sector. The health landscape will only show the national, provincial and district levels. At this stage different sources are used to develop the health landscape which will be verified by authorities and other stakeholders.

Government Interventions

The dismantling of the country's race-based health system began shortly after the democratic elections in 1994 to create as a major priority greater access to primary healthcare especially in the rural areas. In order to achieve this, the government intervened and introduced mechanisms that have an impact on how SMMPs are operated. Some of these interventions will be discussed next. A certificate of need is required as an attempt to redistribute (mostly newly graduated) private healthcare workers to less-well-served areas. This certificate has proved to be controversial possibly contributing to many health workers seeking work overseas (600 young South African doctors in New Zealand; 10% of Canada's hospital based physicians and 6% in the UK are South African). This trend may be an indication of healthcare workers' resistance to some of the interventions. At the same time it is very difficult for foreign health professionals to work in South Africa. The government has introduced "scarce skill" and "rural allowances" as incentives to address the shortages in certain areas. In addition, the government also introduced a year of compulsory community service for newly qualified health professionals. Healthcare workers must attend seminars, workshops and lectures as part of their continuing professional development to earn sufficient points to retain their licence to practice. In an attempt to motivate the private sector to take responsibility for more citizens, medical schemes, with current membership representing approximately 16% of the population, are no longer allowed to reject any application of persons or their dependents. National government also committed itself to the gradual devolution of more health responsibilities to local government. Regulations relating to a transparent pricing system for medicines and scheduled substances have had a major impact on pharmacies and dispensing of medicines by general practitioners.

Patient Data Resource

Medical practices in the healthcare sector are presently subjected to the same pressures as businesses. They accumulate large amounts of patient data yet in most cases they do not utilize its potential value. Data can only be utilized once its complex nature (architectures and flow) and the different views and perceptions of all the stakeholders are understood. This includes the concept of data quality, which embodies technical and social issues within an organizational context and environment. How to assure the quality of patient data and how that affects the relationship with the medical practice and the perceptions of the data stakeholders are non-trivial problems (De la Harpe and Roode, 2004).

Data is of high quality if it satisfies the requirements stated in a particular specification and the specification reflects the implied needs of the user. This is in terms of conformance to its intended use, where the utility and users are the qualifying indicators for data quality [Abate, et al. (1998); Vassiliadis, et al. (1999); Atkins (2001); Loshin and Inbar (2002)]. The concept of quality is relative depending on the different perceptions and needs of the different data stakeholders.

There are three data roles: data producers, data custodians and data consumers (Strong, et al. 1997). Data producers (people, groups or other sources who generate data) have to deal with data generation and externalisation problems or deficiencies. Data custodians (people who provide and manage computing resources for storing and processing data) are concerned with data storage, maintenance and security problems [Wand and Wang (1996); Strong, et al. (1997); Pipino, et al. 2002]. Data quality cannot be assessed independently of data consumers who choose and use these data products.

Patient data as an important resource for the healthcare sector is increasingly manipulated and utilised to improve the delivery of healthcare services and the corresponding technologies are becoming increasingly embedded in all aspects of healthcare (Alshawi et al. (2003). Healthcare data stakeholders such as medical practitioners, hospitals, medical aid schemes, pharmaceutical companies etc., are all interested in different sectors of patient data. Patient data can therefore be used as one of the mechanisms to integrate the different service providers. In public health the research focus is primarily on aggregated patient data whereas the SMMP primarily deals with individual patient data. Patient records are representations of the true state of the patient based on information provided by the patient and interpreted by the health practitioner and recording of the events occurring during the process of care. These records can be either electronic or paper-based. Figure 1 illustrates how the utilisation of patient data can benefit both public and private health in an attempt to close the gap between the two sectors. The research activities, although focusing only on the private sector, should contribute towards the closure of the gap between public and private healthcare.

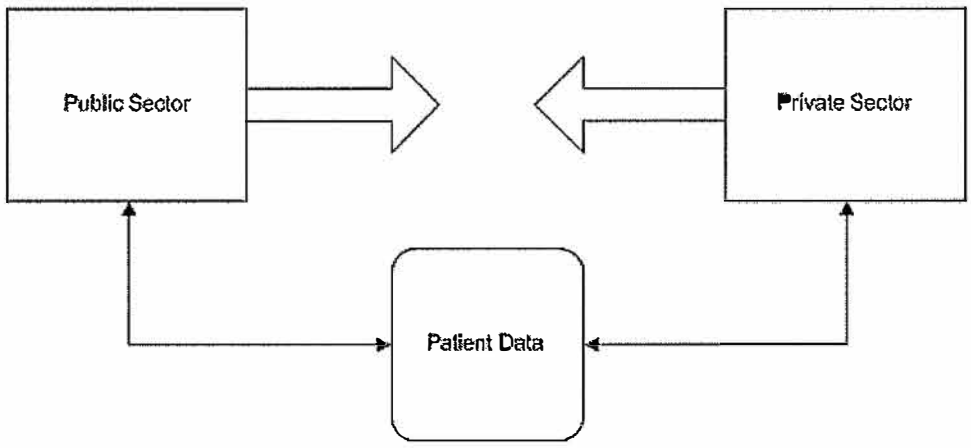

Figure1. Contributing to the closing of the research gap between the Public and Private Healthcare Sectors through researching Patient Data Issues

The most important source for the service delivery for the public sector is the District Healthcare Information System (DHIS) which has been accepted by the National Healthcare Information Systems of South Africa as providing the standard for public healthcare data in the provinces. The National Health Bill (2003) indicates that healthcare personnel have the right and duty to keep record of health information by creating and maintaining health records, protecting confidentiality of the user's health status and access to such records.

The need for human resources development in tertiary education in South Africa

Since 1980 the Technikons in South Africa have positioned themselves as important role-players in higher education with a focus on career-oriented courses with a sound academic foundation (Wiid, 1989) as opposed to universities with their traditional academic programmes. The important collaboration with the industry contributed to the establishment of an important alternative to the traditional universities. The government committed itself in the Education White Paper 3, to the transformation of the higher education system during 1995 to reflect the changes of the new democracy to strengthen its values and practices. At the same time the government recognised the "permanent or intractable tension" between the dual imperatives of development (globalisation) and equity (as means of social redress and equity) (NAP, 2001). As a result of the government's commitment to a changed education landscape, it was decided to reduce the number of higher education institutions and specifically black institutions which were founded during the Apartheid era. After a long process of negotiations with all the stakeholders of higher education, the new higher education landscape was announced in which several institutions would have to merge, in some instances a traditional university with a technikon, in other cases 2 technikons or 2 universities.

An Emerging University of Technology

Cape Technikon and Peninsula Technikon have merged to create the new Cape Peninsula University of Technology which started its operation on 1st January 2005 as one of four tertiary institutions in the Western Cape Province and the only one with a technology focus.

The following healthcare qualifications are currently offered at the two Technikons: Environmental Sciences, Nursing (post-graduate: Occupational Nursing, Primary Healthcare, Oncology Nursing and Palliative Nursing), Biomedical Technology, Emergency Medical Care, Radiography, Dental Technology and Optical Dispensary. These healthcare qualifications have limited IT content. The two IT Departments currently offer IT related qualifications, National Diplomas, B.Tech, masters and PhD degrees. These qualifications do not specifically address any healthcare issues.

The IT qualification, that was curriculated on a national basis by a process of consensus by all thirteen technikons, attracts many students. The active involvement of the industry in the form of advisory committee meetings ensures relevant and up-to-date courses. The focus, however, is currently on education to prepare students for their career with a predominately teaching focus. Cape Technikon only introduced research as a significant important part of the IT qualification during the 4th year IT B.Tech degree during 2000. The institution did not have experienced researchers to supervise the emerging staff and students who embraced the research challenge. The National Department of Education only started recognising technikon research outputs in 1991. Although technikon education included students for the advancement, application, development and transfer of technology and to undertake research after the relevant Act 125 of 1993 was implemented, the Faculty of Business Informatics at Cape Technikon only committed the faculty to research during 2002. This was made possible partly with the support of the NRF (National Research Foundation) contribution to the establishment of research groups with the objective to build research capacity and to increase the number of young researchers in South Africa.

The emerging Cape Peninsula University of Technology will operate in the first year with most activities and structures of the previous two technikons aligned. The research agenda will have to be modified to include activities of Peninsula Technikon. The student demographics profile of Cape Technikon during the past decade is given in Figure 2 to illustrate the changing student profile during the past decade at Cape Technikon. A drastic change is anticipated and the student demographics for 2005 of the merged institution will differ considerably.

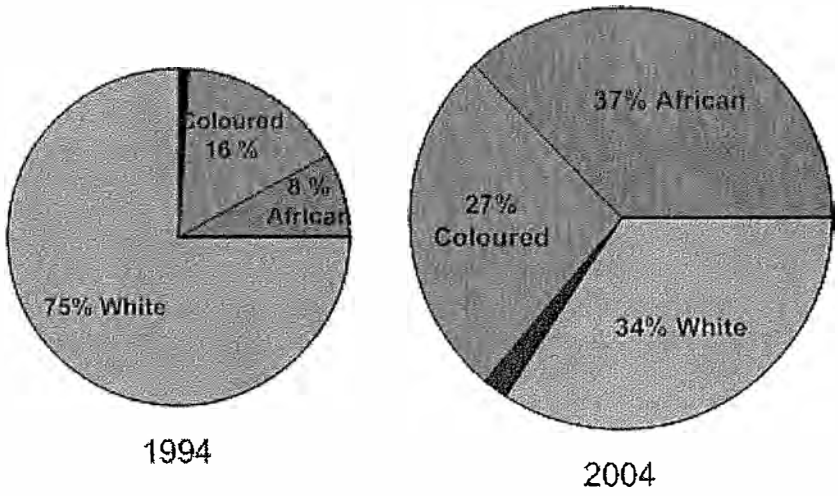

Figure 2, Demography of Cape Technikon Students during 10 years of Democracy

	African		Coloured		Indian		White		Total
1994	710	8%	16 %		129		7009	75%	9381
2004	5 252	37%	27 %		293		5727	34%	16880
Increase (%)	781%				127 %		-18%		80 %

Table 1. Comparison between the 1994 and 2004 student population demography and increase in student numbers.

Each group has the number of students for that group followed by the percentage representation for that year. Currently the three main groups are each representing approximately a third of the total student population. Both the African and Coloured groups show a growth during the ten years of democracy with the African group showing a growth of 781%. The White group has decreased by 18% to the current 34% of the total student population. The changed profile is an indication of the extent of change during the past ten years.

Human Resource Requirements

Human resource requirements of the merged institution need to be specifically addressed whilst considering the primarily technological focus of the new institution. Only then can research capacity be increased to support the research projects proposed by the research agenda. In addition should human resource requirements of private healthcare resulting from the research projects be considered.

An integrated organizational information management model with research framework is discussed in the next section.

An integrated information management model and research framework

The research activities and projects are based on an Information Management model integrated with a research framework. The next sections briefly discuss the model and framework and how the research activities are depicted on the integrated model and framework. The integrated Information Model and research framework is given in figure 3.

Information Management Model

The Information Management Model (Van Loggerenberg, 1995) is a representation of how the information infrastructure of an organisation supports all the business processes. Each process is managed and involves the

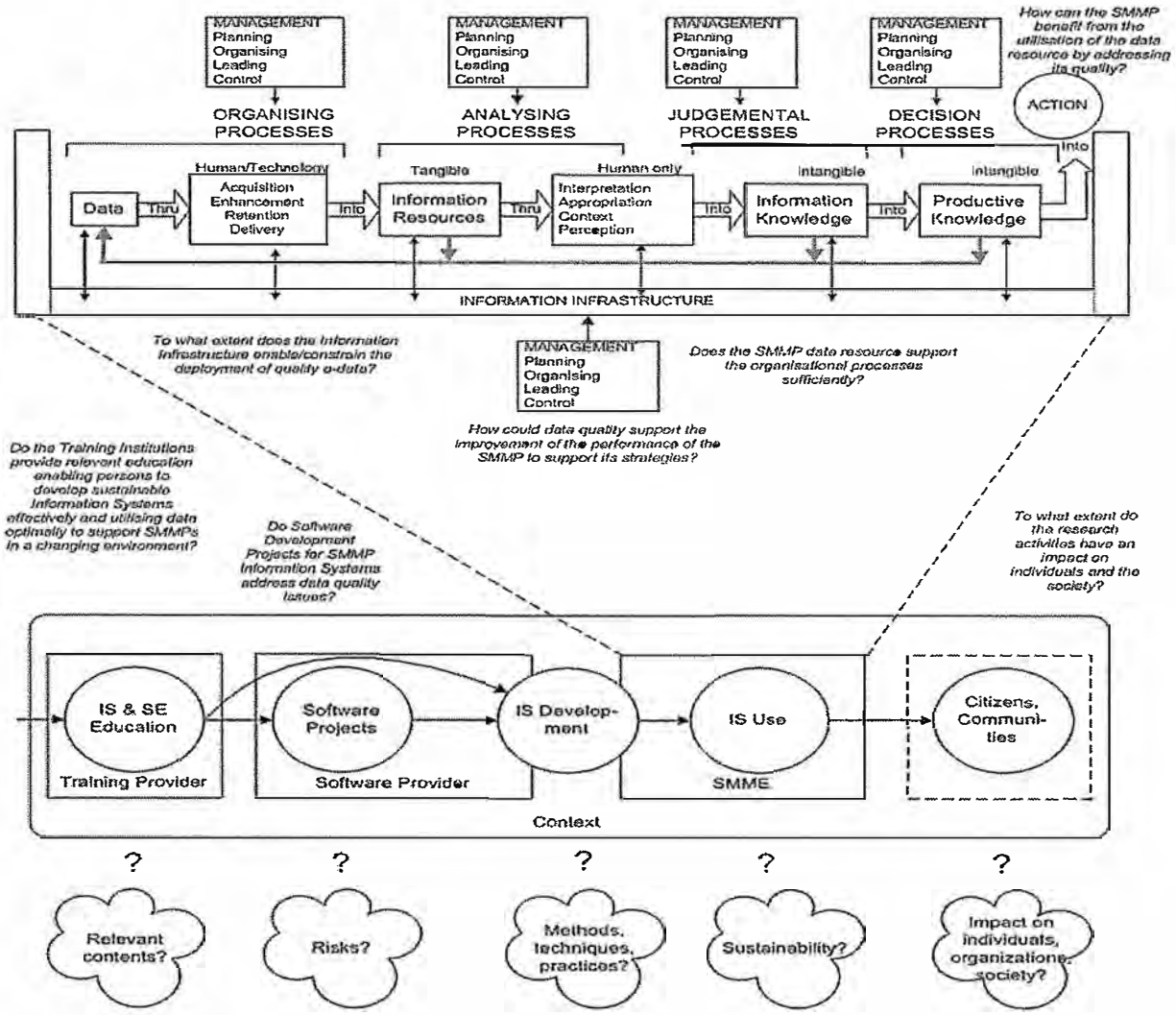

Figure 3. Integrated Research Framework based on Information Management Model (Van Loggerenberg, 1995) and INDEHELA-Methods research framework (Korpela et al., 2000)

flow and transformation of data through the organisation. The research activities addressed by the research agenda are based on this model. In order to extend contextual issues beyond the organizational context to study the impact of these issues on the society training needs, enabling employees of the organisation and software providers to effectively develop information systems should be considered. The effective utilising of information resource to support the analysing, judgemental and decision processes should be addressed.

Research Framework

Korpela et al. (2000) proposed a research framework to be considered by researchers and to some extent also the practitioners of Information Systems. The main research question for their framework is how African healthcare facilities and management get software applications that enable them to use ICT to provide better healthcare services for the people. The framework considers the ability of the training provider to develop courses with content that enables software providers to consider contextual risks when developing information systems. It is possible for an organization to develop their own information systems in which case they need to be trained to use appropriate methods, techniques and practices. The organization then utilizes the information resource and if

their information systems are sustainable, it should that have a positive impact on the individual or society. The framework will be extended after further research in social and organisational sciences have been conducted to provide for the operationalization of the contextual relations into systems development methodology. This research framework has been adopted to guide the research activities of the proposed agenda.

Research Framework integrated with Information Management Model

When integrating the information model with the research framework, the training- and software providers are outside the organizational context and the development of information systems could be either done internally by the organization or externally to the organization. It is unlikely that SMMPs have the capacity to train software developers or their staff the information skills to develop their own information systems. It is therefore fair to assume that the Information Management Model of Van Loggerenberg maps only to the SMME block of the research framework. The organising processes of the organization, using human/technology, transform data through acquisition, enhancement, retention and delivery into a tangible information resource. The organising, analysing, judgemental and decision processes and managing thereof depict IS use of a SMME in the research framework .

The next section deals with the different research topics of the research agenda.

Proposed Research Agenda

Based on the research issues discussed in section 3, the following initial major research topics were identified:

SMMP Training Requirements

The research question(s) deal with whether training institutions provide relevant education enabling persons to effectively develop sustainable Information Systems. The question(s) also deal with opimal utilizing of data to support SMMPs in a changing competitive environment. Three initial training needs identified to be researched are:

Tertiary Education

Currently the IT qualification prepares students for the IT Industry by enabling them to participate in teams developing successful and sustainable information systems. The curriculum for this should cater for all the requirements associated with working in a complex field that is subjected to fast and continuous technological advances. The following are the outcomes of the IT specialization options:

* Business applications: the creation and customization of total integrated IT solutions to business problems and management of those systems.

* Software development: the designing and producing of software products and systems to meet specified needs so that they work reliably and their production and maintenance is cost effective.

* Information systems and technology management: the management of people and technology for creating, modifying and sustaining organisational information systems.

Khalil et al. (1999) identified a gap between the IS curriculum models they investigated to address the information quality needs of organizations. The IS2002 curriculum has limited references to data /information quality topics (Gorgone, et al., 2002). Part of the proposed agenda is to investigate the current IS2002 curriculum to identify topics that deal specifically with data/information quality issues. At the same time the specific information quality needs in healthcare education programmes will be investigated.

Training Researchers

Any higher education programme should include a research component training graduate students in research skills to develop critical thinking skills. The Technikon undergraduate qualification is seen as a professional qualification and needs to be updated with an introduction to relevant research skills specific to the IS discipline. Higher degrees such as honours (fourth year), masters and doctorate degree programmes should have an IS research focus. Research activities such as proposed by the research agenda are important to direct and develop young researchers. The research agenda is crucial for coordinating research projects and to build research

capacity in a specific research niche area. The identification of relevant stakeholders and collaborators is an ongoing task.

Training SMMP Employees

Health workers should be educated to increase their understanding of the role of the information Infrastructure in the successful operation of the SMMP. Training them through short courses, seminars and workshops is crucial to establish an awareness of the importance of their data resources. PRIMIS (Primary Care Information Services), funded by the NHS Information Authority in the UK, is a free training and support service to help general practitioners make the best use of their clinical computer systems and increase data quality in primary care. The Leeds (Pan-Leeds Data Quality Group, NHS, Information in General Practice) group was founded during 2001 to develop and implement city wide data standards in primary care; to provide tools to support creation and maintenance of that data; guidance on coding and information management; to provide quality assurance through analysis and recommendations; to establish and facilitate communication between primary care and related organisations; to liaise with the different organisations on standardising data that crosses the primary-secondary-community care interfaces; to manage their budget and deploy resources to appropriate schemes. These two groups in the UK are examples of how to conduct successful data quality training programmes for medical practices in the UK. A similar training programme in South Africa will have to consider the complexities of the healthcare sector with all its stakeholders involving the government as an important stakeholder. The proposed health landscape should indicate how such a training programme can be implemented.

The above-mentioned can be summarised in the following research questions:

* Do the Training Institutions provide relevant education enabling software developers to develop sustainable Information Systems effectively and for users to utilise data optimally to support SMMPs in a changing environment?

* Does the IS curriculum cover the topics, approaches and techniques sufficiently to equip researchers to do appropriate research in the healthcare sector with the focus on an Information Infrastructure to support SMMPs?

* Do the Training Institutions provide relevant training programmes, courses and content to SMMPs to enable them to create, manage and utilise data of sufficient quality to support the SMMPs?

SMMP Research Requirements

Different aspects of successful SMMP operation through effective ICT use have been researched namely:

Data quality for SMMPs

This research project attempts to understand why data quality is still a concern in most organisations despite several attempts to address different data quality aspects. An understanding of the reasons for this paradox will represent a step towards addressing the pervasive data quality problem. The research questions are:

* Why is data quality still a concern in most organisations?

* Could an appropriate framework be formulated to improve the management of data quality?

Given the above research questions and the approach that will be used to address them, the following empirical issues will also be investigated:

* What are the complexities of data quality and how is it institutionalised within the context of a particular organisation?

* How do the different data stakeholders perceive data quality and its importance in terms of their organisational needs?

The results should improve the understanding of data quality issues and their impact on the success of an organisation. This better understanding could be expected to contribute towards the proper institutionalisation of data quality in organisations through the establishment of stable networks of aligned interests with respect to data quality leading to better storage, acquisition, sharing and representation of data to support organisational information needs (methods and measures).

Data resource requirements for SMMP software development

All healthcare workers in South Africa are required to upgrade themselves to keep up-to-date with current and emerging issues of the medical field. The Continuing Professional Development (CPD) system is administered by the Interim Medical and Dental Profession under the jurisdiction of the Health Professional Council of South Africa (HPCSA). It appears that the CPD information system is not functioning as was originally intended (Makola, 2004). This research study will evaluate the CPD information system to determine why the healthcare workers are experiencing problems when implementing it and identify software development issues that should have been considered. Beaumont (1999) has found that a proper information-driven health system will provide much needed assistance to healthcare workers and that data security, correctness, completeness, reliability and efficiency are contributing to a stable healthcare information system. Appropriate methodologies should consider social and organisational factors in addition to the rather technological emphasis on software development which could be an explanation for user resistance using technologically sound systems [Anderson (1997), Beaumont (1999), Heeks et al. (1999), Korpela et al. (2002)]. Activity theory could be used to study man as an actor in a cultural-historical context with technology as a tool to facilitate work by taking into account both collective and individual aspects. The research questions are (Makola, 2004):

* What are the internal and external factors that affect the running of a successful CPD information system in South Africa?

* Which data quality issues need to be addressed to improve the running of the CPD system?

* How do the social and contextual issues, such as socio-economic, sustainabililty and affordability, affect the day-to-day running of the CPD information system?

The expected outcome will be an improved CPD information system that will be equally acceptable to healthcare workers and authority stakeholders.

Utilization of SMMP data/information

The large amount of data accumulated by SMMPs is an important resource that may potentially benefit them by supporting their decision-making. Business intelligence may enable business to improve their decision-making with Rosser and Kleiner (1995) arguing that any medical service provider in a competitive and changing healthcare environment could not ignore the use of healthcare delivery tools to analyze their data. Medical practitioners need quality information in an easy understandable and usable form for ad hoc inquiries and a generic business intelligence data model is proposed that may assist them with the analysis of their data (Parker, 2004). The focal point of this research project will be on how the data stakeholders of SMMPs view their data in their various data roles and the following are possible research questions:

*Are there any suitable general SMME data models that can be applied to a SMMP?

*What are the unique facets of a SMMP that do not apply directly to general SMMEs?

*What are the data quality issues that need to be addressed within the SMMP to improve the functioning of a decision support system?

*Will the implementation of a data model, using business intelligence principles, improve the relationship between the SMMP and its customers (patients)?

*Will the data model improve or contribute towards performance management and customer relationship management within SMMPs?

The expected output will be a framework that will assist with an increased understanding of how business intelligence principles can be used within the SMMP. This should result in more effective management of the SMMP and its relationship with patients in a competitive environment.

CONCLUSION

All the results of the above research studies should contribute to the eventual benefit of the individual and communities to improve the well-being of all persons in South Africa. The research agenda is summarized as follows:

- Private Healthcare research issues
- Changes in healthcare and education sectors

- Research topics identification
- Research framework adoption
- Research projects execution
- Training for SMMP
- Tertiary Education curriculum
- Training researchers
- Training SMMP Employees
- SMMP Research
- Data quality for SMMPs
- Software development for SMMP
- Utilization of SMMP data/information
- Data collection and analysis
- Research output and contributions

Proper planning of the research projects will contribute towards their successful execution. The research agenda should assist with the coordination of the projects to control sufficient progression and interaction with the different stakeholders. It should be possible to collect data for different projects simultaneously by utilising the same SMMPs. Finally the research output should contribute towards closing the gap between public and private healthcare sectors. Once the human resource needs are established, appropriate training can be offered and the curriculum of Cape Peninsula University of Technology, designed to incorporate these needs. Results from the research projects can be used to investigate wider applicability and to do comparative studies not only in other sectors, but also with similar projects in other countries.

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Standardization of Health Information Systems in South Africa: The Challenge of Local Sustainability

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ABSTRACT

The paper addresses a particular aspect of the theme suggested by the conference: "What are the major infrastructural problems that institutions face in DCs? How can these be overcome?" The paper illustrates the infrastructural challenge of creating a sustainable nation-wide Health Information System (HIS) from the point of view of a small rural hospital. The overall sustainability of the standard-based HIS is dependent on the quality of data, which is dependent on the skillful use of data at the level of collection. In order for the latter to happen, it is argued, 'local sustainability' of the information system at the level of the facility is required. This is even truer for rural hospitals, which run the risk of being otherwise marginalized. The paper draws upon a case study of a rural hospital in South Africa were we document a successful change process where the organization actively and successfully appropriated the national standard. By analyzing factors contributing to the success, the paper contributes to the ongoing discussion on sustainability of HIS in Developing Countries by developing the concept of 'local sustainability'.

1. INTRODUCTION

The implementation of health information systems in developing countries is widely seen as critical for improving the quality of health services (Lippeveld *et al.* 2000). In order to address the health system of an entire country it becomes imperative to standardize the processes of data production and collection at the various levels of the health sector. While standardization is necessary to harmonize and integrate the information, the actual implementation of a standard at the local level often demands flexibility and adaptation (Hanseth *et al.* 1996; Rolland & Monteiro 2002, Timmermans & Berg 1997).

Especially when considering implementation of Information Systems (IS) in developing countries, issues of diversity and context dependency of the implementation sites become extremely relevant (Avgerou 2002; Avgerou & Walsham 2000).

In South Africa the Health Information System Programme (HISP) addressed this challenge by means of a particular standardization and implementation strategy: the creation of a hierarchy of standards to allow flexibility, and particular attention to build "local capacity" (Braa & Hedberg 2002; Shaw 2002). Accordingly, a core set of essential health data is defined and used at all levels (from the facility to the national level) and additional data elements are added at each level to satisfy local management needs. The set of essential data and its hierarchy constitutes what we can call the 'standard'.

Once the standard is implemented, data quality in the entire system must be guaranteed to ensure its sustainability. Possibly, the best strategy is to make sure that the data is used at the level of collection. In order to obtain proper local use, the intervention should also build local capacity in terms of human resources, competencies, and infrastructural support. Hence, it can be argued that the sustainability of the "global" standard-based health IS is highly dependent on achieving a "local" sustainability of a local system which collects and reports the data.

While larger hospitals tend to receive greater attention due to the greater complexity of the intervention, smaller hospitals risk receiving less attention and being marginalized in the process. In fact, rural and smaller hospitals are statistically less significant, usually have less infrastructural support, are less attractive for skilled workers, and it can be argued, but we will demonstrate the opposite, information systems are not so important after all to run them. This paper tries to look deeper into the challenge of "local" sustainability in the particular case of small rural hospitals.

More in general, the following issues have been identified as main sources of problems in achieving the sustainability of IS in Developing Countries (Sandford *et al.* 1994; Heeks & Baark 1998; Littlejohns *et al.* 2003; Braa *et al.* 2004):

- Limited time of donors' financial support
- Inadequate focus on local expertise
- Too narrow interventions (often a sustainable Health Information Systems requires a parallel reform of the health sector)
- Technical bias of projects (inadequate focus on Human Resource development)
- Pilot projects orientation

The paper contributes to the ongoing discussion on implementation of sustainable health information systems in developing countries by better conceptualizing the role of local implementation in the quest for global sustainability. By introducing the concept of *local sustainability*, we intend to stress a necessary condition in order to achieve the sustainability of the whole information system. The paper will show how this concept addresses some of the above mentioned recognized challenges of sustainability.

The remainder of the paper is structured as follows. We will first position our contribution in the ongoing discussion on sustainability of information systems in developing countries. Then we will provide an account of the methodology for data collection, their analysis, and the process of theorization. Subsequently we will describe the case study. A discussion of the main findings will follow, where we will build the theoretical concept of *local sustainability* from the empirical evidence. Finally, conclusions will be drawn.

2. LITERATURE REVIEW

The overall aim of the paper is to contribute to the discussion on sustainability of information systems in developing countries by developing a theoretical concept. In the following section we will provide an account of the ongoing theoretical discussion in order to better position our contribution.

2.1 Sustainability of IS in Developing Countries

Sustainable development was first defined as "[...] development that meets the needs of the present without compromising the ability of future generations to meet their own needs[...]" (Brundtland 1987). This definition has been reinterpreted in the domain of Information Systems to address challenges in the design and in the implementation of sustainable IT solutions (Reynolds & Stinson 1993; Korpela *et al.* 1998; Oyomo 1996; Misund & Høiberg 2003). Within the IS field, other contributions addressed the challenge of overcoming the socio-techno divide (Roode *et al.* 2004), and discussed the role of donors (Kimaro & Nhampossa 2004).

We will here focus on a particular aspect in establishing a sustainable national standard-based health information system. Specifically, we will try to analyze the *local* (hospital) dimension of creating a sustainable global (national) standardized system.

2.2 Sustainability and Standardization

If the implementation of the IS is not local but reaches a national dimension, standardization of the data, the tools for data collection, and the organization around them become key aspects. Especially in developing countries, IS implementation tends to be very sensitive to local context (Avgerou & Walsham 2000; Walsham 1988). This implies that if the endeavor is one of developing the same idea (the standard) in many different contexts, the challenge of sustainability tends to split on two levels: a global level where the standard should be accepted by processes of institutionalization, support, networking, funding; and a local level where the standard needs to be implemented in a way that becomes well integrated in the local context. This creates a tension between the local and global scale development of the information system (Braa & Hedberg 2002). In terms of standards, the global attempt to standardize across local contexts is mediated by the need of local flexibility of the standardized solution (Hanseth *et al.* 1996; Rolland & Monteiro 2002). This is even more true in the case of standards for health care, where the local conditions and work practices tend to reinterpret, if possible, any universal solution as a localized solution, thus creating "local universalities" (Timmermanns & Berg 1997).

In the context of the case study, the standardization of data, data collection tools, and organization support, was a necessary step to reduce the fragmentation of systems and channels of information nation wide. The aim was to

reach a degree of coordination at national and provincial levels so to make management of health issues effective. It follows that the "[...] local-scale development relies on development at the global scale [...]", since "[...] local health units are part of, and dependent on, the larger health system and will therefore need to interact with the higher level health system by way of standards for data collection [...]" (Braa & Hedberg 2002).

This problem has been already addressed by suggesting that sustainability should be built "[...] through ongoing and continuous *translations*, around both the vertical (local appropriation) and horizontal (diffusion) axes [...]" (Braa *et al.* 2004). The concrete strategy suggested is to create an inherently flexible standard in the form of a hierarchy of standards. A core standard, an essential data set, is decided at national level and applied everywhere. At each lower level of the hierarchy (province, district, facility) the data set can be expanded to include other indicators, which will be collected in the level below.

These strategies, which so far proved to be adequate, tend to address the tension between standardization and flexibility and find a balance between the global and the local.

3. METHODOLOGY

For the research presented in the paper we adopted an interpretive approach to case study (Walsham 1994). Initially, a considerable amount of data was collected during the visit to over 10 hospitals in Eastern Cape in the time span of two years (2003-2004). The hospitals approached were all experiencing evident problems in collecting and reporting health data. The majority of the hospitals visited were situated in rural areas in the Transkei region in the Eastern Cape Province.

Preliminary analysis of data from the hospitals indicated that the data was of poor quality and not suitable for use by managers to inform their decision making. This raised the question: how to build local capacity, and adopt a context sensitive implementation strategy of a national standard, that would ensure a sustainable HIS? It became clear at that point that visiting a hospital which was submitting high quality data could provide insights and ideas on how to intervene in more problematic hospitals. Lady Grey was selected from among a group of several hospitals in Eastern Cape with a "functioning" information system. Its rurality and small size make it a suitable case study example. The initial idea was that it could be compared to a similarly small hospital in a more rural area in the Transkei.

4. CASE DESCRIPTION

In this section we will present the case study. First we will provide some background information on the nation-wide Health Information Systems standardization program in South Africa. The information system analyzed in the case is part of that standardization program. Then we will describe how the information system works at Lady Grey hospital and how it has been changed after the first implementation in 1999 as part of the standardization program. Finally we will make a preliminary analysis of contingent factors which contributed to the creation of a locally sustainable information system.

4.1 The quest for a national standard for routine health data in South Africa

As part of the Reconstruction and Development Program (ANC 1994b) in South Africa an effort was launched for the restructuring of the health sector in all provinces. This effort included the creation of a unified Health Information System (HIS) (ANC 1994a). The HISP (Health Information Systems Programme) initiative addressed this challenge in Western Cape by defining an Essential Data Set (EDS) of indicators and by developing a District Health Information Software (DHIS) to support data collection, aggregation and analysis at the district level. Eventually, the HISP initiative scaled up to national level and the standardization process was carried out in the other provinces in a coordinated manner (Braa & Hedberg 2002; Braa *et al.* 2004).

In Eastern Cape the implementation of the DHIS and the EDS standard was launched in 1999. As part of the implementation, hospitals were provided with new forms and registers for data collection, computers, and the DHIS software. In addition, training sessions were organized for the hospital staff (Shaw 2002).

The situation in many hospitals in Easter Cape was also assessed in 1999. The results indicated that:
"Data is collected 'at all levels in hospitals, but most of it is never used'.
Indicators are submitted to the district offices, but give a 'very bland picture of administrative activities, and no feeling of what goes on inside hospitals'.

'Registers are non-standardized, and tend to be anarchic, and hand written', and often on an assortment of different types of paper and books.
'Analysis of data is minimal at all levels'." (Shaw 2002)

4.2 Implementation at Lady Grey rural hospital

In the following sections we will provide the account of how a small rural hospital in the Eastern Cape Province managed to appropriate the standardized HIS in a successful and proactive way.

4.2.1 Background

The Lady Grey Hospital is a small hospital of 25 beds in the northern area of the Eastern Cape. The town of Lady Grey was founded in mid 1800 and is reachable with a tar road.

The hospital is staffed with two sessional doctors (amounting to a full-time equivalent doctor) doctors and 40 staff (of which 20 are nurses) as well as a hospital manager, an admin officer, one information officer, and a clerk. The registers, the DHIS and a computer were installed during the DHIS rollout in Eastern Cape in 1999. The intervention put in place an information workflow complete of registers, forms, a computer and the DHIS application (see figure 1 for a simplified overview).

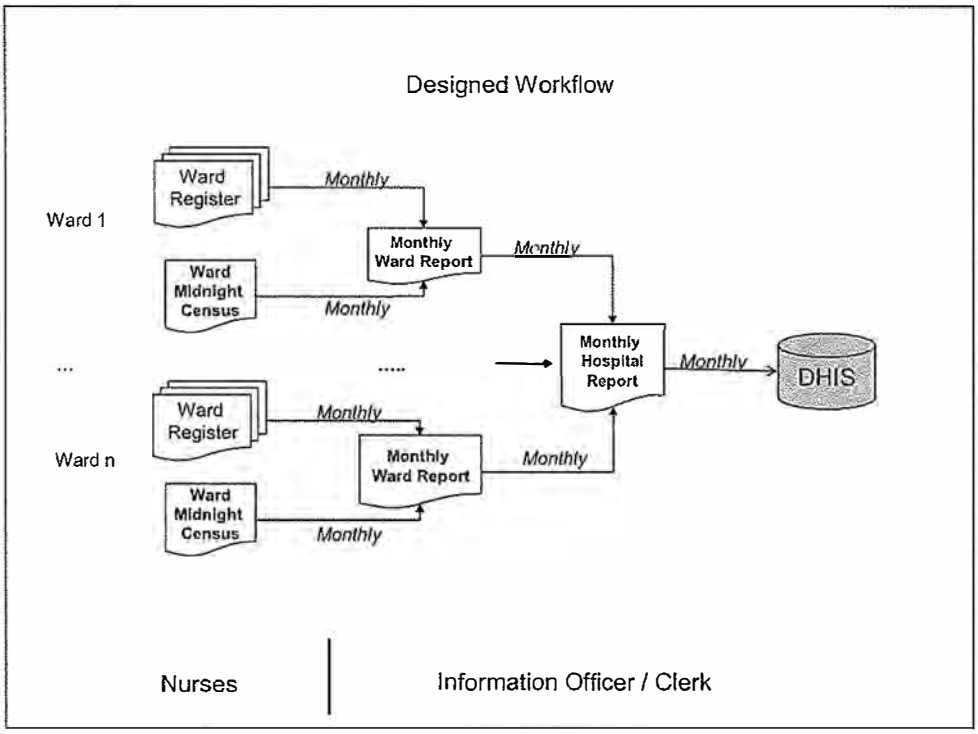

Figure 13 The workflow of information initially implemented by HISP in 1999.

The Ward Registers are books where the nurses should enter the data about the patients that are admitted and discharged. There is one long line to fill for each patient and often the fields (like the type of diagnosis or type of separation) simply require a tick (hence the name "tick register"). The Midnight Census is a form compiled by a nurse during the night shift indicating the number of patients present during the night.

The hospital is one of a group of hospitals, called the Provincially Aided Hospitals. They have been functioning as semi-autonomous hospitals in the Eastern Cape and other provinces for over 10 years. They are to raise 10% of their budget from private patients. A service level agreement between the Eastern Cape Province and the hospitals defines their size (the number of beds) and the corresponding amount of financial aid (which is 90% of their total budget).

In order to run and sustain the *network* a budget review committee periodically assesses the budget and the routine health data, and provides recommendations to the managers of the hospital. To maintain the budgetary

information, the hospitals are provided with an Excel application developed by the budget review committee with the aid of the provincial office.

4.2.2 The Information System of the Hospital

Creativity and Teamwork

The situation we found in Lady Grey was surprising. The registers and the mid-night census form provided during the DHIS roll out were not in use. The staff in the hospital decided that these were too time consuming (especially for the nurses). Hence, the manager, the clerks, the admin officer, the sisters, and the matron discussed what information they needed to collect and how, and designed new forms according to their needs. They developed an own solution which is now working (Figure 2), which both provides data for the DHIS (which is mandatory) and data for themselves in a manner that better suits them.

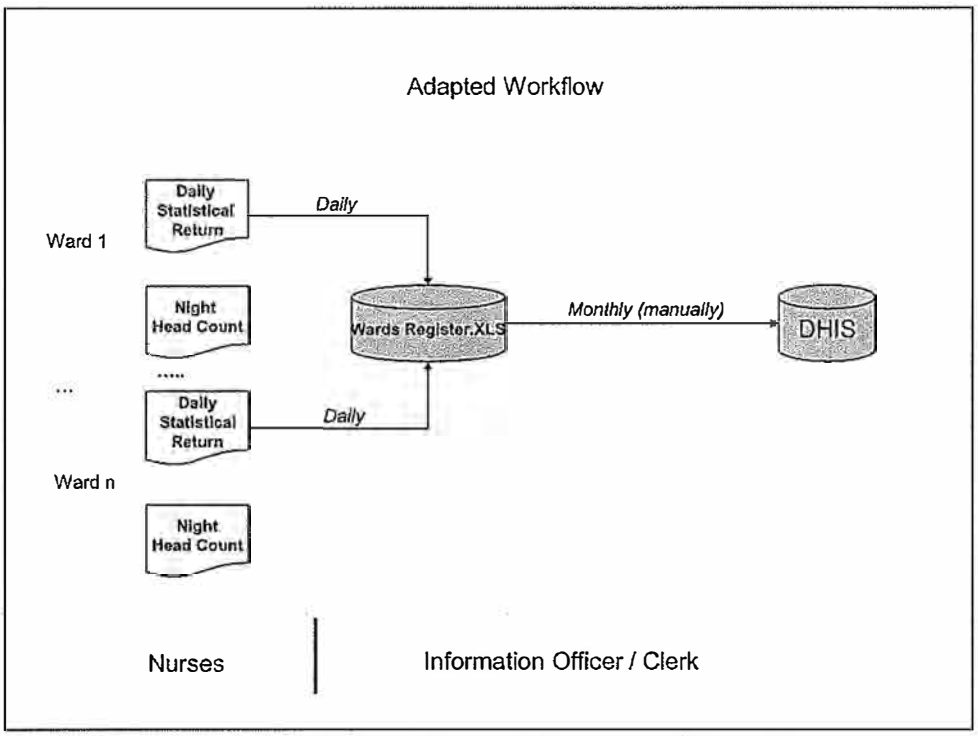

Figure 14 The redesigned information workflow: most of the registers are gone.

Interestingly and in contrast with basically all the other hospitals visited, for most of the wards they did not use an admission/discharge register, nor a midnight census. They substituted them with two forms compiled daily. One is the Daily Statistical Return, the other is the Night Head count. The first one lists all admissions/discharges of the day and is filled in by the sisters as the patient arrives or is discharged. At the end of the day the admin clerk does the round of the wards and collects these forms and writes each single entry in the ward register spreadsheet (a replication of the ward register in Excel). The nurses now have to enter very simple data compared to the ward register. They also do not need to calculate and compile the monthly reports. Overall the nurses perceived that their administrative work was considerably eased.

The second form is used by the sisters for local use to know every day who is in the beds in the wards. At the end of the month the information officer easily counts and calculates the aggregated data from the Excel sheet and enters them in the DHIS monthly report to be handed to the district information officer. At the same time she updates several graphs depicting various monthly statistics, which we found hanging in the manager's office. Examples of those statistics are: in-patients admissions, turnover of patients, bed occupancy, theater activity (source of large costs), and number of private (paying) patients.

The observed re-appropriation of the implemented standardized workflow was possible primarily thanks to the availability and teamwork of skilled and competent people. The roles of both the hospital manager and of the

information officer where key to the change process: the manager had the vision of an improved local IS and the information officer had the necessary competencies and computer skills to implement it.

The main results of the redesign are:
- Nurses have less and simpler data to enter and no monthly report to compile: they perceived that their administrative work was considerably eased
- There is one form less: the midnight census is indeed redundant as the same information can be calculated from the Excel sheet
- There are less steps in the workflow which require manual calculations and data entry, hence there is less possibility of creation and propagation of mistakes
- As the Ward Registers are now replicated in one single register in Excel, immediate/daily analysis of data is possible
- A drawback, however, is that the clerk or the information officer are now required to be more skillful and have now a greater responsibility.

From what we have observed, the redesigned system still had considerable space for improvement since not all the computing capabilities of Excel where exploited.

The manager stressed that all this was possible only through a good cooperation and teamwork:
"We try our best and we really work as a team. You can't do anything if you don't have the support of others. Then you can close down the Hospital."

What was surprising for us was that no external intervention, aid, or pressure played a role in the vision and execution of the redesign. It was all possible with the given tools (by the DHIS rollout) and the local human resources.

Use of Information

As mentioned, graphs were regularly (monthly basis) produced from the DHIS. When we asked the manger what she would do with all that information and the graphs, she replied that she used it mainly for two things: to manage the hospital and to do financial negotiations with the health district administration.

Looking at the graphs on the wall we also asked a more direct question:

Researcher: *What do you see from these graphs?*
Manager: [Looking at the in-patient admission statistics] *The in-patient admission is a lot. It shouldn't be so many admissions at the same time. So I must go and look that doctors don't just seek patients to admit them to set the stats high. Turnover tells me how quick the patients move out; also the average days per patient that they don't stay too long. That they don't stay longer than 5-6 days. Our bed occupancy is confronted also with the daily costing from kitchen and cleaning.*
[In the bed occupancy graph] 100% will be 25 beds. But we are using more.

R: *And the peak in the theater activity the end of last year?*
M: *There was a problem with cesarean sections. We had a lot of problem births. This other graph is to see how our private patients go because we need to make up our 10% [10% of the hospital budget must be privately funded by 'private' patients].*

If we look at the complete picture of the Information System in place in Lady Grey Hospital (Figure 3) we see that there are several end-users of the information at local (ward) level, hospital, and district (or higher). . We also see that the three computerized components (the DHIS, the Ward Register Spreadsheet, and the Budget Spreadsheet) all play the central role of preparing and aggregating the data for the end users.

In general we can observe that all the information is collected and used for a reason. There is no fall-out of information (information collected but not reported or used) and the information channels are also sometimes integrated (e.g. the budget review information builds upon an indicator calculated with the DHIS).

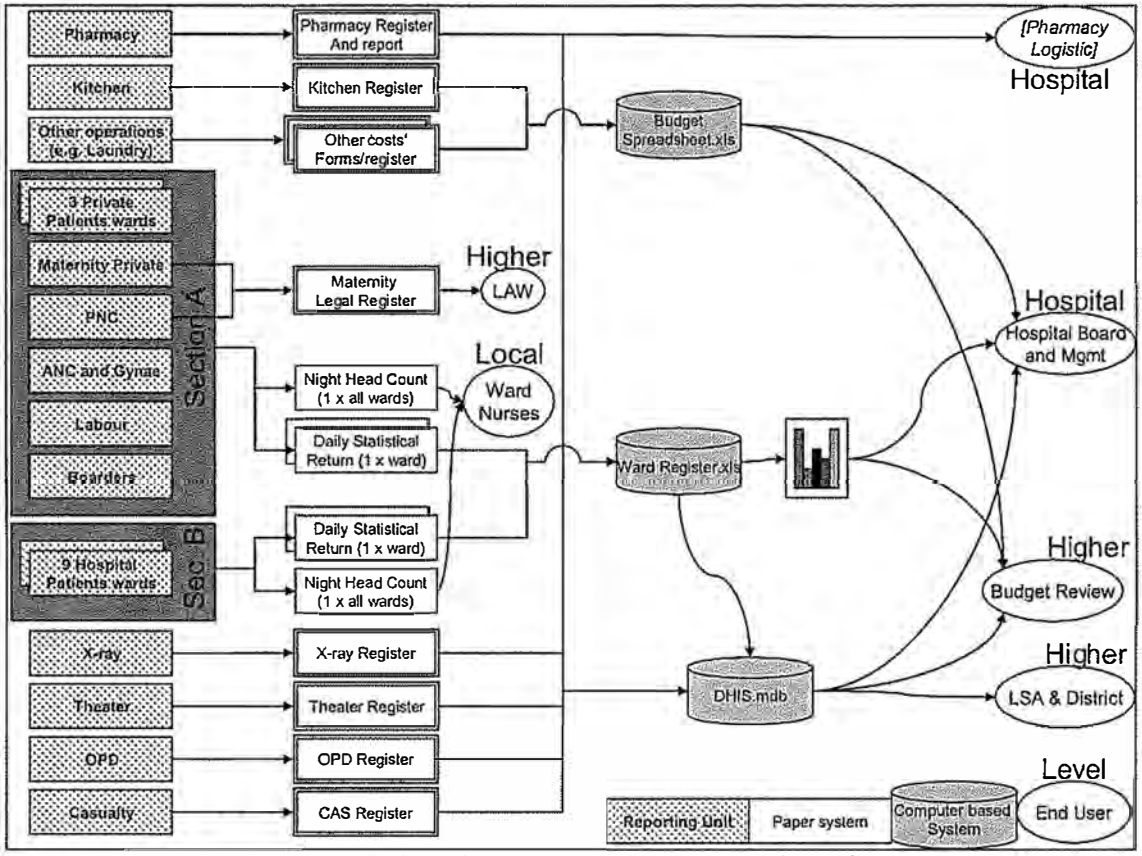

Figure 15 The overall view of the information system at Lady Grey Hospital.

Layering of information systems

A last element we would like to highlight is the relationship between the described hospital information systems and the budgetary system used in the network of Provincially Aided Hospitals. During the budget review session of this hospital, which we attended, the most relevant indicator that was used to evaluate the overall management performance was the cost-per-patient-day indicator. This indicator is created by dividing the total costs of the hospital by the number of in-patient days. The number of in-patient days is taken from the statistics created from the hospital information system (particularly from the mid-night census data) and entered in the DHIS. This indicator should be between 350-400 ZAR/in-patient-day.

It is worth noting that usually bad quality of the in-patient-days indicator reflects in underreporting the number of in-patient-days. Hence, the more accurate the number of in-patient days, the lower the cost per patient day, the better the indicated performance, the better the outcome of the budget review.

Hence, the layering of one information system over another creates dependencies and forms of incentives for keeping high the quality of data.

4.2.4 Analysis of contingent factors

In this section we will do a preliminary analysis of some themes which emerged from the fieldwork that resulted to be relevant for the positive outcome of the local redesign and change process.

We don't have evidence that the training during the roll out implementation of the DHIS was of a better or worse quality than for other hospitals of the same size. Nevertheless, it was clear to us that the manager and the admin officer had sufficient competence to fill any possible gap. The information officer of the hospital implemented the clever idea of replicating the Ward Register in Excel, so to have continuous and accurate statistics. This shows a probably above-average level computer literacy compared to her colleagues in other rural hospitals in Eastern Cape. The whole organization acted as a team, sharing knowledge and creativity. This is evidently the main source of knowledge, rather than the simple sum of the individual skills.

Moreover, teamwork also meant participation so that the nurses had their requirements of having less administrative workload fulfilled. Being part of the final solution, made them motivated to sustain it. This kind of teamwork and leadership evidently kept the motivation of the staff high.

The Provincially Aided Hospitals (PAH's) are not financially advantaged compared to provincial hospitals (who get 100% subsidy, and are not autonomous). In reality the cost per patient day in the PAH's is less than that in the provincial hospitals. However, it appears that there is a caring ethos that has been created around being an employee of a PAH, that translates not only to care of patients but also to care of the environment. It therefore appears that these hospitals are financially advantaged, but in reality their ethos translates to taking a greater interest in keeping the environment around them neat and tidy. Still, the hospital had to constantly negotiate with the district office to have their workload recognized financially. In fact while the official bed count is 25, around 35 beds are actually occupied.

Finally, as mentioned, Lady Grey managed to become part of a wider network of Provincially Aided Hospitals. As illustrated, the network sustains itself by means of mutual assessment and mentoring. In addition, the network can act as one actor for bigger arguments with the province. In a way, the network helps the hospital to exit its rurality and risk of isolation.

5. DISCUSSION

In this section we will further analyze the data to understand the factors which positively contributed to the reinvention and sustainability of the system. In the light of such factors we will then generalize one step further in order to better conceptualize what *local sustainability* means and why it is relevant to achieve the overall sustainability of the *global* system.

5.1 What can be learned from Lady Grey

5.1.1 Creating space to allow local innovation to ensure local relevance

Building local infrastructural and HR capacity is certainly a key aspect for a sustainable information system (Shaw 2002). In Lady Grey Hospital this capacity already existed when the rollout of the DHIS and of the data collection tools was undertaken. A key role was played by the manager with her rigorousness, willingness to improve the situation, and determination to achieve the improvement. These skills were nourished by the PAH network which met frequently (four times per year) and encouraged local innovation to improve care provided to patients. Her awareness of the importance of a participatory approach in the design of the new solution was probably the most important factor for the success of the change process. In this sense her authority was used to lead the change, rather than simply as a mean for control of bureaucratic activities. Certainly, without the skills of the information officer the changes would have probably not been so radical.

The main characteristic we would like to highlight, and which we suggest constitutes the core of the success, is the willingness to improve together with the ability to reflect and question the status quo. In this hospital, the status quo created by the DHIS implementation was simply the starting point for a local reinterpretation of what that implementation meant. The people in the hospital managed to make a distinction which is not always understood: the distinction between the means and the goal of the implemented standardization. The actual standard (the Essential Data Set, or EDS) is an abstract construct and constitutes the specific goal of the standardization process. The tools and the workflow design which is provided are elements around the standard, but are not the goal. They are the suggested means to achieve the specific goal of filling in the data sets with appropriate data.

These tools (registers, forms, and workflow) are provided as a "start-up" kit, where the information system is lacking or is too fragmented. But the hospitals are not really bound to them. In principle they can arrange their own information system as they like, as long as good quality data is passed above (e.g. through an EDS). Lady Grey Hospital did not fall in the easy trap of simply following the orders of the province in a bureaucratic way. Instead, with a bit of entrepreneurial spirit, they reorganized the system to meet the goals of the province and their own as well. What we can hence observe is that the EDS and the DHIS acted as enabling (i.e. not as constraining) factors through their reflexive appropriation by the hospital.

Local adaptation of the standard is particular important in obtaining buy-in to the system, which is important to ensure long-term sustainability. Because they have "made it their own" they have an interest in seeing it work

and continue to "invest" in the systems and processes to keep it working. In other hospitals, where there is less innovation, the system and tools are seen as "coming from province" and the product is "for province". In this case there is little interest whether the product (the data in the EDS) is either good or bad, because it has little local relevance.

5.1.2 Networking against marginalization

Rural hospitals always run the risk of being marginalized. Poor communication and transport, often together with poor socio-economic conditions, make hospitals in rural areas less attractive for skilled employees. In the worst case a vicious circle of de-motivation and lack of teamwork between professions in the organization risks setting the hospital in a dangerous downward spiral. While this phenomenon has been observed in one particular hospital in the Transkei (see endnote 1), it is certainly not the case of Lady Grey. Yet, the risk is concrete, and, when addressing the implementation in other small and rural hospitals, it should be taken into account seriously.

A possible counter-strategy to fight the risk of marginalization (whether real or potential) is becoming part of an active network of similar hospitals. By becoming part of the Provincially Aided Hospitals, Lady Grey Hospital escaped this risk gaining advantage at least on two fronts: (1) the hospitals in the network mutually support and learn from each other, by frequently monitoring and improving each other's management performance; (2) the network acts as an institutional amplifier of Lady Grey Hospital's voice and needs.

5.1.3 Layering of information systems

A last aspect we would like to emphasize is the relation between the Financial Budget information system and the information system for health data.

As mentioned in the case section, the cost-per-in-patient-day indicator constitutes a clear example of new possibilities opened by a working health information system: the better the health information system, the more accurate the in-patient-day indicator, the more accurate the evaluation of the management performance (cost-per-in-patient-day).

Thus the layering of health and budget information systems creates a double incentive:

- in order to have the budget review working, the health information system of the hospital must also be working
- the more accurate the in-patient-day indicator, the lower the cost-per-in-patient-day indicator (usually bad quality of the indicator reflects in an underreporting of in-patient days), the better the performance indicator and the outcome of the budget review.

5.2 What does Local Sustainability mean

In this section we will try to summarize our findings and generalize them by explaining the meaning and the role of the concept of "local sustainability".

In the theory section, we argued that the (global) sustainability of a standard-based system is dependent on its use, which in turn is dependent on the quality of the information which is reported. Apparently, the best strategy is to make sure that the data is used locally where it is collected, which in turn requires flexibility of the standard and the establishment of local capacity (or unleashing the local potential) to maintain it.

What we intend to stress is the perspective of the local site (in our case a small rural hospital). What is clear from the case is that local use, local capacity building, and local appropriation of the standard are part of the same effort of locally achieving a sustainable information system.

But *local sustainability* is more than sum of these parts: it implies a shift of responsibility from whatever hierarchical level above to the very people managing the data locally. *Local sustainability* is reached not simply when the data is collected and used properly, but when the local organization at the bottom of the hierarchy is also capable to proactively reinvent the standard by independent reflection on its own work.

In this sense, sustainability is not the reaching of a state of equilibrium; it is rather created, reinvented, and continuously negotiated. All this implies a proactive engagement of the *local* in re-appropriating what is imposed by the *global* in its own terms and following its own vision with entrepreneurship.

Finally, we can analyze how these findings address the more general set of common problems of building a sustainable system. Referring to the list of issues in the introduction, we argue that by creating the conditions for local sustainability:

- The implementation on the local level becomes less dependent on the limited time of donors' financial support
- Increases the focus on local expertise
- Yet, does not prevent too narrow interventions; however a precondition for local sustainability is a dialectic relationship with a more general or global effort
- By focusing and leveraging on local resources of innovation, forces a more holistic (not purely technical) approach

6. CONCLUSIONS

In this paper we have addressed the challenge of creating a sustainable standard-based nation-wide Health Information System. More specifically we have analyzed how the quest for sustainability splits on a global and a local level. In both levels sustainability needs to be created and managed, and is dependent on the other level. Hence, on the local level the main challenge faced by hospitals is to create a locally sustainable information system using what is provided by the standardization process as a starting point.

With the help of a case study, we have demonstrated how *local sustainability* is not simply a state to be reached. It is rather a continuous change process where the local organization reflects upon and proactively reinterprets its own way of working.

Finally, we have emphasized how creating the condition for *local sustainability* is particularly important for small rural hospitals in order to reduce the risk of being further marginalized. The case suggests that cultivating a sense of entrepreneurship, networking with other similar hospital, and interlinking information systems within the hospital may be possible strategies to create *local sustainability*.

[Endnotes]

(1) In a previous fieldwork we visited several rural hospitals in the Transkei region. In one of them (the smallest) it appeared to us that building a working Information System was the least of the problem. The organization was under stress; the employees were demoralized and there was very little team work between the various professions.

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IT Perspectives: The Case of Women in Sub-Saharan Africa

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ABSTRACT

While Sub-Saharan Africa women have historically assumed the roles of housewife and subsistence farmer, the reality is that these women have not had the opportunity to become a strong and viable part of modern economies in that region. However, this trend is changing with the exponential growth of information and communications technologies (ICT) globally, giving many historically underserved women access to computers, the Internet and other related technologies. This paper examines the integration of women in ICT in Sub-Saharan Africa. We do so by exploring major bottlenecks to such integration from historical and contemporary perspectives. In discussing multiple projects, we demonstrate that these bottlenecks are being addressed through ICT initiatives in the region, and how Sub-Saharan Africa women are getting integrated into the information age and becoming contributors to their countries' socio-economic development strategies. We also employed interviews to understand women's reactions to these initiatives. Our findings indicate that women were highly optimistic, embracing ICT as a practical mechanism for achieving entrée into the labor force. However they perceive significant structural barriers, such as gender discrimination in hiring practices, difficulties balancing ICT work with traditional roles in the home, and lack of employment opportunities which would allow them to capitalize on their ICT skills.

INTRODUCTION

"ICTs are important tools that provide the [Sub-Saharan Africa] women access to lifelong learning and training, to productive assets, and to credit. Neglecting to give women access to these tools not only deprives them and their families of income, but reduces the skill-level of a nation's human resource, limits national productivity, and bars a country from being competitive in the global market" (International Telecommunications Union, 2003).

In this paper, we examine the extent to which the positive impacts enabled by ICT are realized by women in Sub-Sahara Africa (SSA), a region which is home to 33 of the 48 poorest nations of the world, and a region almost nonexistent in much of mainstream ICT research (see Appendix A). Sahay and Avgerou (2002) rightly stated that ICTs "are expected to play a key developmental role" in poor countries. They further stated that "many see in these technologies the potential for turning around uncompetitive industries and dysfunctional public administration, and for providing unprecedented opportunities for the information-intensive social services, such as health and education." In the same study, they lamented the acute lack of research which focuses on developing nations. This absence is extremely troublesome given that developing nations are home to 2/3 of the world's population.

In this paper, we focus SSA women and the institutions which serve to redress the digital divide. The concept of the digital divide has been useful in articulating disparities in access to ICT, particularly in the developing world, and it has been used to inform the development of policies and programs to promote social inclusion and

economic development. More recently, the digital divide discourse has broadened to include not only issues relating to access to ICTs, but also the capability and capacity in leveraging ICT for the advancement of historically underserved populations, the development of local content on an ICT platform, and the creation of appropriate policy measures to cultivate an enabling environment for using ICT (Isaacs, 2002).
In the developing country context, digital divide policies and programs typically utilize ICT to advance modernization, promote social and economic development, and improve of the status of women. Gender inequality tends to slow economic growth, according to Christiaan Poortman, World Bank Vice President for the Middle East and North Africa:
"No country can raise the standard of living and improve the well-being of its people without the participation of half its population. Experience in other countries have shown over and over again that women are important actors in development - to hold them back is to hold back the potential for economic growth" (World Bank, 2004).

There are several reasons for this link: Women can play an instrumental role in lifting their families out of poverty through labor force participation; Women are also more likely to invest their earnings in their children, and assume critical, life sustaining responsibilities without which men and boys could not survive much less enjoy high levels of productivity. Thus, women's empowerment is important for determining a country's economic success and sustainability. The extent to which women and girls benefit from development policies and programs has a major impact on a countries' overall development success and growth prospects (World Bank, 2004; Hafkin and Taggart, 2001; Liu and Wilson, 2001).

In what follows, we describe the longstanding barriers, such as access to education and traditional divisions of labor, which help to explain the low participation rates of women in ICT. Next, we describe our research approach along with data collected from women in SSA, in particular, Kenya. We present these findings and offer our analyses on these data. We conclude with implications for policies to further social, economic and technological inclusion for underdeveloped African countries.

TRADITIONAL BOTTLENECKS
Even though ICT has become a global industry whose development may help to improve the quality of life of women in SSA, there are certain traditional bottlenecks that have hindered participation in the formal labor force. Because the women in this region have historically been active in agriculture, local trade and other economic pursuits, a large majority of working women are found in the informal sector of the labor force (Hafkin and Taggart, 2001). For instance, SSA women grow 80% of the food produced, and yet few are allowed to own the land they work. They work twice as long as men, often 15 to 18 hours a day, but often earn only one tenth of the wages of their male counterpart.

As SSA women attempt to move into contemporary forms of employment and finance, they face a variety of legal, economic and social constraints. For instance, it is often more difficult for women than men to gain access to ICT resources and credit. Agricultural extension and formal financial institutions are biased toward the male and against the female clientele, this despite women's major role as producers. In fact, some laws in many countries in this region still treat women as minors. In Zaire, for example, a woman must have her husband's consent to open a bank account. As a result, they are less well equipped than men to take advantage of the better income-generating opportunities that have emerged in the region. The positive side is that these factors have spurred the growth of women's groups and co-operatives that give loans, health care and educational initiatives, and provide other relevant services to women (See the Federation for American Women Educationalists[12], and FLAME[13]).

Education continues to be a major bottleneck to integration of the SSA woman into contemporary economies. Under colonial rule, access to education was restricted (Lewis, 1999) as African children were prepared for the roles deemed appropriate by the imperialist power brokers. Sons of chiefs had privileged access to schooling; a practice that served both religious and political motives that mainly benefited the imperialists. These practices set precedents that were subsequently followed by African families, thereby giving priority to the education of boys, leaving girls uneducated to later serve as housewives and child-bearing 'machines'. Prior to independence, few African children attended school beyond the primary education level (Lewis, 1999; Mbarika, 2004). By 1960, only 25 percent of primary-school-age children were in school, compared to twice that number in Latin America

[12] http://www.advanceafrica.org/index.html
[13] http://flamme.org/index.html

and Asia (Lewis, 1999; Mbarika, 2004). As a result, one of every two women in the region is illiterate. Even within the last decade, technical education necessary to gain computer and related ICT skills still remain elusive for many SSA women. Moreover, there is a very negative attitudes towards schoolgirls in scientific and mathematical fields (Liu and Wilson, 2001; ITAA Blue Ribbon Report, 2003). Therefore, science and technology education is lowest among women in SSA.

Technical education is a significant determining factor in who acquires desirable skills and becomes a valuable worker and who does not. SSA has very low percentages of women in technical and vocational education (TVE). Moreover, the women who do enroll in TVE are often only prepared in lower paying areas as secretarial work, garment manufacture, home economics and hairdressing. For example, according to a UNESCO report, girls in Namibia account for only 11.8 percent of the total enrollment in secondary technical and vocational education institutions. Most are in the garment manufacture and secretarial sectors as already observed. In Malawi, girls are hardly represented at all in primary and lower-secondary technical schools, making up an average of only 4.6 percent of such enrolments from 1989 to 1993 (Atchoarena and Delluc, 1999). Men, however, are often trained in more economically productive fields such as mechanics and electrical and civil engineering.

Breaking the traditional role of the SSA woman presents a challenge to the government agencies, international development agencies, educational institutions and companies working to broaden the participation of women in ICT-related fields. However, it also presents many opportunities because, in spite of their oppression, women are still the major economic force in the region, partly because they constitute a larger part of the population and partly because of the sheer size of the female workforce (Hafkin and Taggart, 2001; Liu and Wilson, 2001). Therefore, it becomes important to give these women an opportunity to play a major role in the ICT sector. ICT can facilitate access to education and health care, minimize isolation, facilitate economic growth, alleviate poverty, and provide empowerment. Training women in ICT can help alleviate the acute shortage of ICT skills need by employers in SSA (Mbarika et al., 2002).

RESEARCH APPROACH

Although the level of integration of women and ICT in SSA are among the worst in the world, there have been major efforts to address this dilemma. Several organizations are helping women to become major players in the socio-economic development agenda of their countries in general, and in the development and use of ICT in particular. However, the question remains, how have women responded to and benefited from these programs? To examine this question, we conducted a study comprised of two distinct parts. First, we present two programs providing ICT access and training to SSA women. We selected these programs because they represent locally managed initiatives for alleviating the digital divide. In the second part of the study, we sought to understand the specific differences ICT has made socially, economically, and politically for the African woman. This led us to conduct interviews with women who were the intended benefactors of the digital divide initiatives. Using Cameron's (1992) notion of "empowering" research, we conducted interviews to solicit the views of the researched group about the phenomena under investigation. Women are part of the emerging digital environment, and it is, therefore, necessary to understand issues explaining how they are actually benefiting from and using ICT. It is equally important to understand the obstacles faced by women. However, a particular danger associated with researching and writing about disadvantaged groups is that the researcher herself may contribute unwittingly to the oppression of the group by making statements which could be interpreted to support popular prejudices (Herring, 1996). Accordingly, we are careful to avoid generalizations that could contribute to the popular stereotypes about women in developing countries. We also were cautious about romanticizing the technology and seeing only its positive and beneficial impacts.

We conducted structured interviews with thirty two women enrolled in the Bachelor of Business Information Technology program at Strathmore University in Kenya. All of the woman were in their 3rd or 4th year of study, and were enrolled in the "Social Impact of ICT" course. We constructed an interview guide based on a prior study of the conceptualization of ICT by African American women in the US (Kvasny, forthcoming) which was organized around the following themes: perceptions on gender and ICT, motivations and barriers to learning about IT, definitions of the digital divide, desired outcomes of computer training, and the value of the IT training and access. During the interviews, each woman was instructed to reply to the questions by anonymously writing her response in a booklet. The booklets were, then, sent to researchers in the US. This interview process resulted in an average of 4 pages of hand written responses for each interviewee (approximately 128 pages of interview texts). Thus, the interviews were highly structured with each woman receiving exactly the same questions in the

same order. We employed traditional techniques for analyzing qualitative texts by finding illustrative themes which emerge across interviews (Glaser and Strauss, 1967; Miles and Huberman, 1994).

FINDINGS

In this section, were present the findings from both parts of our study. We begin by discussing two ICT projects to give a sense of the diversity of implementation models for taken on the challenges and opportunities found in the SSA context. Next, we provide the voices of women who are the intended benefactors of these types of ICT programs

Part 1: Ongoing Women-Based ICT Projects in Sub-Saharan Africa

The Zimbabwe Women's Resource Center and Network (ZWRCN)

The Zimbabwe Women's Resource Center and Network (ZWRCN) is a non-governmental gender and development organization created in 1990 whose mission is to help women in both the public and private sectors make informed decisions about political, economic, and social aspects of their lives (ZWRCN, 2003). ZWRCN describes its activities as "... gathering, interpreting, publishing, and disseminating rare and life-changing information in order to allow women to make informed choices about their lives and to influence government to implement gender-sensitive policies" (ZWRCN, 2003). Recognizing lack of information as a major hindrance to the development of women, ZWRCN empowers women by providing information on gender, women's health, and legal issues in Zimbabwe. ZWRCN has one comprehensive information department called Information Services, made up of four units: the Documentation Center, Internet Café, Gender and Development Talks, and Publications. Following are discussions of some of the activities undertaken by each unit to promote women's education and empowerment.

The Documentation Center houses approximately 5000 documents, catalogued by theme, which provide information on gender issues such as violence against women, rape, land ownership, environment, politics, and decision making. The center was formed in 1990 to help encourage research to fill information gaps on women's issues. The collection is composed of books, directories and files about various organizations, dictionaries, reports, theses, periodicals, newspapers, magazines, videos, CD ROMS, and fact sheets. Library members borrow documents for specified times at a reasonable fee (ZWRCN Documentation Center, 2003). The Center attracts journalists, army officers, researchers, students, policy makers, and women's rights activists and serves as a rich resource on these issues (Information, 2003).

The ZWRCN's Internet Café project is the first initiative dedicated to training women locally to use the Internet and email to communicate, search for needed information, and enjoy the benefits of being part of a global online community (Internet 2003). Some of the activities undertaken by the Internet Café are:

- Provide email and Internet access to women and girls at affordable costs.
- Provide training to women and girls to make information technology more accessible.
- Disseminate information on CD-ROMs and other formats to reduce dependence on the Internet.
- Communicate with other women's groups, networking, online chat and the exchange of critical information on health, economic, and legal issues affecting women.
- Provide training for women in finding tools and resources on the Internet.

ZWRCN holds monthly Gender and Development talks that aim at collaboration between individuals and institutions to address gender issues. These discussions are lead by local, regional, and sometimes international speakers who are invited to facilitate controversial issues affecting SSA women. Examples of topics covered are gender budgeting, and HIV/AIDS and how it affects women (Information Technology Association of America, 2003).

ZWRCN has taken different approaches to communication and the flow of information between women in the grassroots and women organizations. One useful method is through published "fact sheets" on politics, law, and other issues, which are available in the main local language translations. These fact sheets have encouraged more women to get involved in political and economic issues so they become better informed. The flagship of ZWRCN is the quarterly magazine called *Woman Plus*. This magazine covers all of the themes and the latest news (Information Technology Association of America, 2003).

WOMEN CONNECT!

The Women Connect initiative is a project that aims to empower women through effective communication strategies in media, information technology, health, and networking among women owned nongovernmental organizations (Mukenge, 2002). Launched in January 1999, Women Connect aided women NGOs specifically in Uganda, Zambia, and Zimbabwe. ZWRCN works with Women Connect to train women at dissemination workshops. Women Connect also helps to set up IT facilities in rural areas. Its mission is to provide vital health-related information to rural women and to encourage them to share their problems or concerns regarding health issues with other women groups or networks. For this purpose the women are given training in email, Internet access to download health information that meet their particular needs (Mukenge, 2003; Women Connect, 2003a). This initiative is undertaken by sponsorship from The Pacific Institute for Women's Health (PIWH), The Bill and Melinda Gates Foundation, The University of Southern California (USC) Annenberg Center for Communication, and Global Fund for Women.

One of the major objectives of Women Connect is to help women NGO's to use ICT towards the advancement of women's health. The Small Grants program is a project undertaken by Women Connect to give technical assistance to NGOs. Case in point, twenty-six women's groups conducted projects in Zimbabwe, Zambia and Uganda. The area of focus of the projects was media or ICCT. Eight projects focused on email, Internet and ICCT training for their staff. Five projects were related to development of websites and two other projects were related to establishing Internet cafes and IT training to women's groups and women parliamentarians. Nine organizations implemented multi-media campaigns in rural community newsletters. Most of the projects provided information about women's health, particularly HIV/AIDS, cancer, STDs, and safe sex (Women Connect, 2003b).

In summary, the aforementioned ICT projects illustrate initiatives that promote use of ICTs among African women. However, we saw the need to gather a richer set of data to better understand the intended beneficiaries of these technologies. We sought to let voices of the SSA women speak. In the next section, we present additional findings based on interviews with 32 women based in Kenya.

PART 2: Women's Responses to ICT Initiatives

We begin by discussing SSA women's motivations for participating in these ICT initiatives. Next, we discuss the women's expectations for leveraging ICT to improve their life chances. We conclude by examining the degree to which the women felt empowered to realize these expectations.

MOTIVATIONS

Nearly one-third of the women (10) participating in the ICT educational program were motivated by the belief that substantial job opportunities awaited them upon graduation. The ICT sector was described as a new and "*an upcoming field*", and as *"a new field in Kenya and a very dynamic field which affects all aspects globally"*. They also believed that there were few ICT professionals because the training was not widely available. For instance, one woman remarked *"not many people in Kenya have this sort of information [and] this is because currently in Kenya there lacks professionals in this field"*. Not only were jobs seen as plentiful, they were also seen as well paying. *"I think IT is a field that will provide me with a means of earning good income in future"*. They wanted to be more competitive in the job market, and this ICT program provided opportunities to *"get a qualification that enables them to work in a relatively new area of work in Kenya"*. Some women were more entrepreneurial, and saw ICT as a way to start their own business. *"Since I have the basics of IT and my course provides a grounding I can build up on my own, I could start my own enterprise using this knowledge"* . For these women, business ownership was once a dream that now can potentially be achieved. *"Given that I would like to learn IT so that I run my own IT firm in future. If I do not take this chance to learn IT, then my dream will not be accomplished"*.

However, the majority of the women (23) were motivated to attend the ICT programs for more intrinsic and political reasons. Fifteen women cited reasons of personal challenge. *"It is a challenge that they believe they can meet and it is a field that greatly stimulates the intellect."* Nine were simply motivated by interest. *"I chose to do this course because I had an interest in IT, which started to develop when I was in high school."* Thirteen women were motivated by perceived gender inequalities. For them, ICT offered an opportunity for overcoming oppression and achieving parity with men. *"Gone are the days when there were specific jobs/careers for men and women. Women now want the challenge." "More and more women want to play an active role in their society and in the world...women want to be involved in the ICT sector (not to be left behind by their male counterpart)"*. ICT would enable them to engage in an activity which has been historically perceived as a male

domain. *"The simple reason why women participate in this IT program is because men do the same thing. Equality is something that women have all been fighting for and have accomplished their goal. If a man can participate in IT, why shouldn't a woman do the same thing?"* Women not only want to do the same thing as men, they want to adopt ICT *"because it is beneficial to them too as much as it is to men... it will enable us as women to compete fully with men in jobs"*. There was also the belief that women in ICT-related professions are *"able to successfully represent other women in our country" and "able to adapt to contribute to society by raising awareness about what IT can do for a nation"*. Thus the training provided immediate benefits to the recipient, but also external benefits to other women and the entire nation. These were pioneering women who were not content to *"stick to the stereo type that certain jobs are for women"* . They wanted to demonstrate that *"they are clever enough to prove that they can master a tough course like IT and do well"*.

EXPECTATIONS

All of the women that we interviewed had expectations which centered on very practical and production oriented uses of ICT. Theory was greatly devalued while practical experience was prized. *"More exposure to IT. More of practical and less of theory"*. The women desired a strong technical competency in a wide variety of skills. *"I expected to emerge as an IT expert with knowledge of the foundations and development of technology. I expected to be up-to-date on the technology trend and be able to manage information systems, develop them, code, implement, manage and have ICT at my fingertips". "I also expected that I would have acquired managerial skills to be able to manage an assigned project in IT field."*

Some women were overly optimistic in their expectations for leveraging their ICT skills in the labor market –*"It will guarantee an instant job."* Others were more conservative, and discussed their desire to apply their skills in the service of an employer. *"When I enrolled for it I hoped that by the time I would be graduating, I would be a competent professional able to integrate my IT knowledge into a business environment"*. The women, however, were not totally devoted to their employers needs. They also saw a space to meet their own personal needs. For instance, one woman discussed *"how I could use them (various concepts of IT) in the future to accomplish various goals both personally and for whichever organization I may find myself working in."*

DEGREE TO WHICH ACTUAL TRAINING MET EXPECTATIONS

The women were overwhelming positive in their assessment of the training they received. *"The training met my expectations in terms of improving my IT skills and also my management ones."* The two most positive aspects were the practical lessons (*"I would not change the practical lessons, lab sessions, projects")* and the industry and community internships (*"Attachments give us chances of employment after completion of the course.")* The managerial focus was also appreciated -*"[I would not change] the business aspects of it, the management part."* Women valued the technical skills they acquired -*"It met the expectations where different units touched on different area of IT like networking, programming, web design."* Ethics and humanities helped women to develop a well rounded appreciation for the role of ICT in organizations -*"[the aspects I would not change are] the humanity electives and ethics classes."* Eleven women reflected positively on the learning environment. They felt a sense of community in the classroom and enjoyed *"the way the class members all contribute ideas"*. Tutors were an integral part of their learning community. *"I would not change the tutorial system where a student gets to talk to a personal tutor. It's quite good." "The school has been able to adequately provide the necessary things especially the software and hardware"*, so the women had sufficient access to technology resources.

The one area, however, that the women most wanted to change was the theoretical basis of the training. These were women looking for careers, so they had little time revel in theoretical discussions. *I think the training is too theoretical and application of it in an actual working environment is difficult."* They wanted hands on training in which they would learn about the intricacies of the computer. *"I would introduce a technical class not examinable but a period where students go to the lab and open up a computer"*. The training was also perceived to be broad but shallow. *"It is so wide that it only gave basics of the IT world which proved to be disastrous out in the field."* The women desired very specialized, in depth knowledge of ICT. *"Introduce specialization in later years, say if one likes the field of networking, then they can specialize in it."* Some women so privileged the technical aspects, that they saw ethics and the more interpersonal aspects as unnecessary. *"Reduce workload by getting rid of subjects such as ethics where we learnt about the mind and soul and the will." "I didn't expect to learn courses such as Ethics. In my opinion, this time should have been allocated to programming practice."*

DISCUSSION AND CONCLUSION

Just as technology has found its way into the SSA region, so have educational opportunities for women. Several organizations have recognized that women in particular are at a greater risk of being left out of the economic and social opportunities that technology can offer, a situation even more pronounced in countries where women already fall behind in social and economic prosperity. In response to this need organizations have made valuable contributions in the region. While these programs have been successful in raising ICT awareness in SSA, these endeavors are far from reaching women in critical masses. To help achieve this goal, these initiatives must take advantage of training modules such as "train the trainer" so that women who complete the available training can return home to teach women in their home countries who cannot travel.

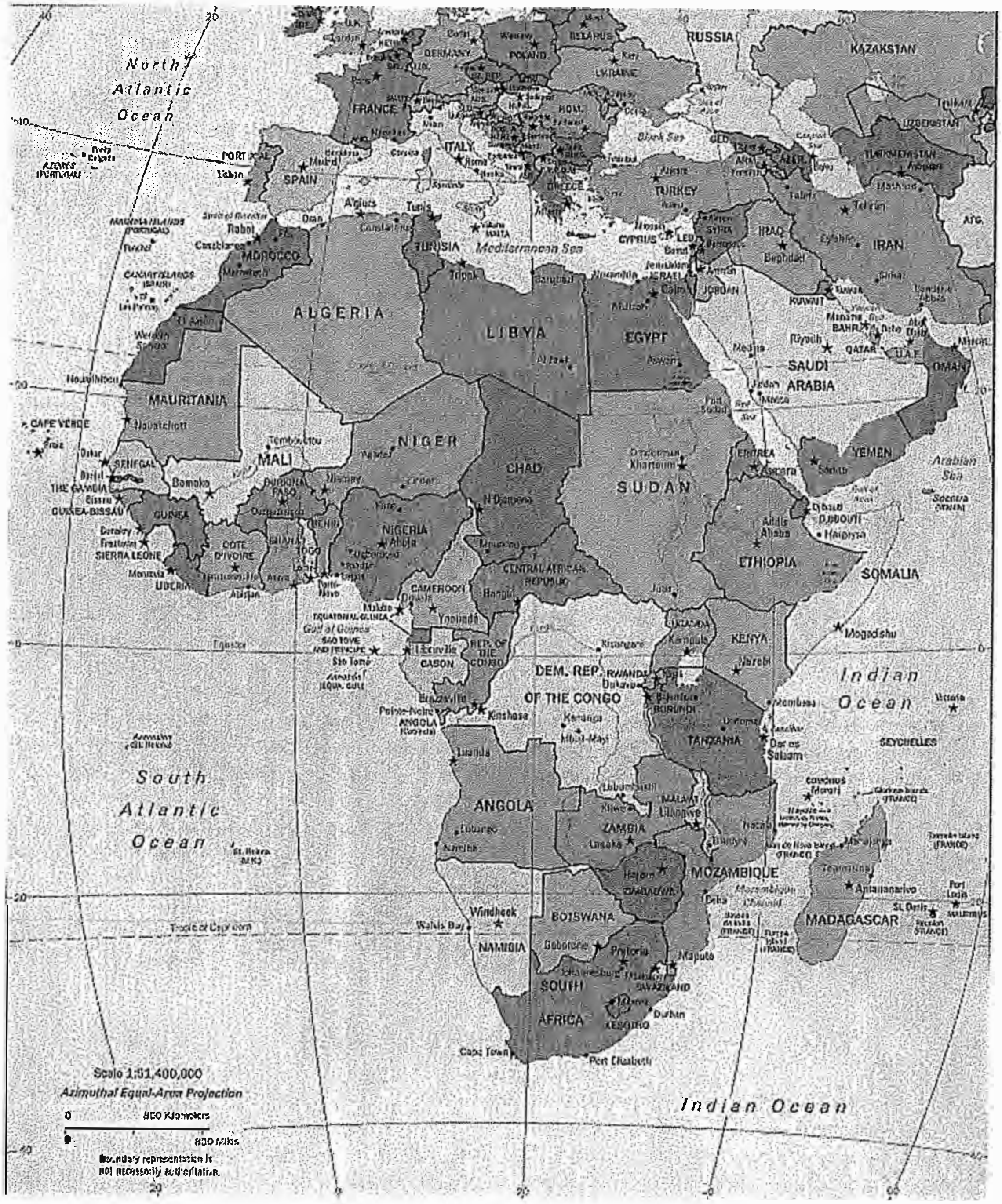
While much is being done to improve the skills and awareness of women, this knowledge will have limited impact without complementary structural changes in employment practices. The women in the study noted severe limitations in leveraging their ICT skills in the labor market. Through policies such as financial incentives and gender sensitivity training, employers in the region should be encouraged to hire female graduates of these ICT programs. Given a leveled play field, women in the SSA region will have increased opportunities at entering ICT careers.

Although they are off to a positive start, the women in these countries need both more support and more action. Much of this support will come in the way of public policy, national infrastructure and education beyond narrow definitions of ICT access (Payton, 2003) in the developing countries' context where such access is still limited to the urban "elites". Some African countries have started to address this dilemma by granting tax relief for investors that establish businesses in rural areas. Other African countries such as Cameroon have enacted a duty-free policy on all computer imports. Such a move has and will continue improve the numbers of women that acquire and use ICTs. Further, special incentives are provided for women to establish public Internet cafés. In fact, in some African countries like Tanzania, most of the Internet Café owners are female (Mbarika et al., 2004). Gone are those days when the Sub-Saharan African woman was only good for cooking, cleaning, and child bearing. African women have become a strong part of the social, political, and economic structure of the region. There are now many female government ministers and CEOs in several African countries. Many African women are entrepreneurs and have access to professions that were historically reserved for men. Also, some African countries have governmental ministries dedicated to women affairs and that consistently address issues of gender equality. Therefore, the old stereotype the West keeps portraying about African women being treated as second class citizens is just not true. African countries have gone a long way to create a platform for the advancement of women.

Based on this platform, our paper examined the integration of women in ICT in Sub-Saharan Africa using both primary and secondary data sources. We used multiple projects to demonstrate that the previously mentioned African gender stereotypes have been and continue to be addressed through ICT initiatives in the region. We further illustrated how Sub-Saharan Africa women are getting integrated into the information age. Based on the interviews, we illustrated that women were highly optimistic, embracing ICT as a practical mechanism for achieving entrée into the labor force. As countries within the region continue to encourage such initiatives, the North-South digital divide will continue to close.

Appendix A

Sub-Saharan African countries are located south of the Sahara Desert in Africa. In the map below, Sub-Saharan Africa consists of all those countries south of the Tropic of Cancer (latitude 23½° N).


North Atlantic Ocean
RUSSIA
KAZAKSTAN
BELARUS
POLAND
GERMANY
UKRAINE
FRANCE
SPAIN
PORTUGAL
ITALY
GREECE
TURKEY
Black Sea
UZBEKISTAN
TURKMENISTAN
SYRIA
CYPRUS
IRAQ
IRAN
ISRAEL
JORDAN
KUWAIT
QATAR
SAUDI ARABIA
OMAN
YEMEN
Mediterranean Sea
TUNISIA
MOROCCO
ALGERIA
LIBYA
EGYPT
Cairo
MAURITANIA
MALI
NIGER
CHAD
SUDAN
Khartoum
ERITREA
DJIBOUTI
ETHIOPIA
SOMALIA
Mogadishu
SENEGAL
Dakar
THE GAMBIA
GUINEA-BISSAU
GUINEA
SIERRA LEONE
LIBERIA
COTE D'IVOIRE
GHANA
TOGO
BENIN
NIGERIA
Abuja
CAMEROON
CENTRAL AFRICAN REPUBLIC
EQUATORIAL GUINEA
GABON
REP. OF THE CONGO
DEM. REP. OF THE CONGO
Kinshasa
UGANDA
KENYA
Nairobi
RWANDA
BURUNDI
TANZANIA
Indian Ocean
SEYCHELLES
South Atlantic Ocean
ANGOLA
Luanda
ZAMBIA
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
Windhoek
BOTSWANA
Pretoria
SOUTH AFRICA
SWAZILAND
LESOTHO
Maputo
Durban
Cape Town
Port Elizabeth
MADAGASCAR
Antananarivo
Tropic of Capricorn
Equator
Indian Ocean
Scale 1:51,400,000
Azimuthal Equal-Area Projection
800 Kilometers
800 Miles
Boundary representation is not necessarily authoritative.

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Extranet Technology and Inter-Organisational Knowledge Sharing: Understanding the Influence of Mexican Cultural Values

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ABSTRACT.

Over recent years, a number of commentators have claimed that many societies recognise knowledge, rather than traditional resources (such as cheap labour or natural resources), as being their most valuable resource (Drucker 1994; OECD 2001; World Bank 2003). This recognition has resulted in many advanced economies (e.g. Canada), regions (e.g. European Union) and cities (e.g. Barcelona) developing new economic policies which seek to enhance the competitiveness of their traditional industries, while also developing new knowledge based industries. This society, or knowledge society as it is widely recognised, is characterised by the World Bank (2003) as having several distinct features, for example, shorter production cycles, greater levels of innovation, increased importance of small and medium enterprises (specially in the services sector) and a reliance on ICTs, just to name a few.

The theme of the knowledge society has attracted the attention of academics and practitioners alike, all of them looking for different ways to describe and explain the effects it has caused in organisations. One of the results of this exploration has been the emergence of a line of research dedicated to understand how organisations share knowledge through the use of technology. Unfortunately, this literature has focussed almost exclusively on intra-organisational knowledge sharing in large organisations and in developed countries (Easterby-Smith & Araujo 1999; Tsoukas 2002), neglecting inter-organisational knowledge sharing (Orlikoswki 2002). Further, the majority of these studies have ignored, consciously or unconsciously, developing or 'in-transition' economies, and this omission has been accentuated by the lack of literature that considers small and medium enterprises (Levy, Loebbecke & Powell 2003). Such organisations play a vital role in the economy providing most of the employment and consequently are vital to knowledge generation. It is precisely these omissions in the literature that this research will address.

Specifically, this research will critically review how a SME in Mexico uses extranet technology in order to share knowledge with its clients and thus gain competitive advantage. The case study is based on an eight-month in-depth ethnographically informed empirical study in one Mexican SMEs. This comprised of primarily direct observations and structured and unstructured interviews, both on-line and off-line. The chosen SME, FirmCo, provides services in the consulting industry undertaking management consultancy in areas such as production, marketing and finance.

Specifically, this paper examines the relationship between FirmCo. and ManCo., one of its clients, and how local cultural values influence the use of technology and inter-organisational knowledge sharing. We will explore the following themes: (i) how local cultural values affect the use of extranet technology and (ii) how these same values influence inter-organisational knowledge sharing. For purposes of analysis and drawing conclusions, these themes are interpreted through relevant concepts from Wenger's (2001) social theory of learning and different theoretical cultural sources (e.g. Paz 2003; Kras 2001).

INTRODUCTION.

Over recent years, a number of commentators have claimed that several economies, such as Canada and the European Union, rely on knowledge, rather than traditional resources such as low-cost labour and natural resources as being crucial to their competitive well being (Drucker 1994; OECD 2001; World Bank 2003). It is claimed that such societies have an increased reliance on small and medium enterprises (SMEs) and on Information and Communication Technologies (ICTs) (World Bank 2003). Research in this domain has focussed almost exclusively on intra-organisational knowledge sharing in large organisations and in developed countries (Easterby-Smith & Araujo 1999; Tsoukas 2002; Walsham 2001), neglecting inter-organisational knowledge sharing (Orlikoswki 2002). Further, the majority of these studies have ignored, consciously or unconsciously, developing or 'in-transition' economies (Walsham 2001). This omission has been accentuated by the lack of literature that considers small and medium enterprises (Levy, Loebbecke & Powell 2003). Such organisations are central to the economies of developing countries. Finally, there has been a paucity of literature that has considered the influence of local culture in the use of technology (Walsham 2001).

This paper will address these omissions by examining how cultural values influenced an ICT enabled project designed to assist in the sharing of knowledge between staff in two Mexican SMEs. Specifically, the case study is based on an eight-month ethnographically informed empirical study of a Mexican consulting company, and its relations with one of its clients, a Mexican manufacturing company. The consulting company is an SME that provides consulting services in areas such as production, marketing and finance. The knowledge sharing initiative will be analysed through a number of concepts pertaining to learning developed by Wenger (2001), as well as different theoretical cultural sources relevant to Mexico (e.g. Paz 2003; Kras 2001).

This paper is divided into four further sections. Section two briefly provides an account of the theoretical and methodological underpinnings. Section three describes the empirical setting and section four provides the analysis and interpretation of the case. Finally, section five presents the conclusions.

THEORY AND METHODOLOGY

This second section is divided into two subsections. The first subsection presents the research methodology and methods. The following subsection reviews the theoretical underpinnings.

2.1. Methodology and Methods.

This paper reports on the first eight months of an ethnographically informed empirical study. The total project will continue for a further seven months. One of the authors spent between three to four days each week in the field interviewing, observing, taking notes, talking and sitting in the different meetings. Through this period, the author was able to collect different documents and construct a view of the field. At the same time, every three months, the author flew to the United Kingdom to meet with the other author and review the progress. Other methods, such as e-mail and telephone conferences were used to discuss and reflect on the research.

The methods adopted were all qualitative research. They primarily comprised of observations (sometimes participant and sometimes not), social interactions and structured and unstructured interviews. Detailed field notes were recorded during interviews and observations. This was preferred to tape recording as it was felt that subjects being interviewed may be less inclined to speak openly. However, it is important to acknowledge that details may be lost when tape recording is not used, yet it is believed that the strengths of this approach outweighed its weaknesses. Further, one of the authors was conscious that due to the extent and depth of his engagements with the consultants, owners and managers he may have become too close himself to the empirical setting and thus may come to take much of that which he observed as given. He took care in ensuring he remained as detached as possible. Further, the researcher was also conscious that he might also influence those being researched (Bourawoy, 1991; Van Maanen, 1979).

2.2. Theory.

This subsection is divided into two further sections. Subsection (2.2.1.) reviews the most important Mexican cultural values that influence the workplace and subsection (2.2.2.) reviews relevant concepts of Wenger's social theory of learning.

2.2.1. Culture as Context: Mexican Cultural Values and their Influence at the Workplace.

Cultural values have become an important analytical tool for management and information systems research. According to Rodríguez and Ramírez (1992), management research has drawn upon cultural values because they exert significant influence over human beings' behaviour in the workplace. In other words, cultural values help to understand numerous attitudes, dispositions and behaviours not only of organisations but also of the people that work for them. Walsham (2001) also argues that there are different issues to consider when analysing "... the introduction and use of information technology in countries with cultures far removed from those in the Western world." The reminding of this subsection will review several relevant cultural traits that influence the Mexican at the workplace.

Family.

The value that the Mexican gives to the family is probably its most important cultural characteristic. Kras (2001) argues that loyalty to the family is still the most important factor in a person's life and might explain why there is a greater preference for hiring and promoting friends and family members. Further, commentators have suggested that the workplace tends to be an extension of home, as the general manager or owner of the organisation substitutes the 'father' figure (thus becoming the moral authority).

Individualism.

According to several authors (such as Paz 2003, Kras 2001 and Rodríguez & Ramírez 1992) Mexico is an egocentric country, which means that it places the individual first. This egocentricity, or individuality, is seen, for example, in the importance the Mexican gives to interpersonal relations and the low-level participation in community oriented tasks. At the workplace, individualism implies that relations should be carefully cultivated in order to obtain the commitment of employees (Kras 2001).

Rodríguez and Ramírez (1992), and Ibargüengoitia (1990), explain that this individuality leads to the almost inexistent motivation for teamwork, and also the excessive need to obtain power and status through 'high-level' personal relations. According to Andrade (in Rodríguez and Ramírez 1992, p.85), "in Mexican organisations there are strong fights for power and departments tend to become feuds that compete between themselves, thus collaboration and interdepartmental teamwork are almost inexistent."

Commitment.

The concept of commitment has a different interpretation in Mexico to other countries (Rodríguez & Ramírez 1992). Mexican commitments are merely seen as declarations of good intentions and by no means are always honoured (Kras 2001). This is claimed to contribute to low-levels of trust between individuals and little, or no, social responsibility (Durán 2000d; Paz 2003; Rodríguez & Ramírez 1992). This lack of commitment directly affects many aspects of organisational life, such as lack of teamwork and social participation.

Trust.

The centuries of being deceived and manipulated by its rulers is attributed to have led Mexicans to have very low levels of trust between each other (Del Bosque 2002), as Paz (in Rodríguez & Ramírez 1992) graphically highlights, the Mexican only believes in two things: the Virgin of Guadalupe and the National Lottery! This lack of trust, together with the family concept, assists in explaining why friends and relatives are hired in preference to strangers who may be better qualified, and also why teamwork is not valued (Rodríguez and Ramírez 1992; Ibargüengoitia 1990; Kras 2001; De la Cerda 1999).

Further, the lack of trust in Mexican organisations is reported to contribute to there being a high degree of centralisation with regard to power and decision-making. This lack of trust, together with a lack of commitment, is exemplified by the need for Mexicans to have everything in writing before any transaction takes place.

Figurative Language.

Mexicans disguise their true intentions when they speak (Rodríguez 2002). As Homs, in Del Bosque (2002) argues, in order to know the real intention of a person the reader, or listener, must be very intuitive to be able to decipher the real message. In other words, he must be able to read between lines. A further Mexican characteristic derives from childhood: Mexicans are encultured into not saying something that could hurt someone, and consequently understand that saying 'white lies', or half-truths, are perfectly acceptable. This figurative language, and reading between lines, is normal and widely acceptable with mature people and at work. This should not be seen as a lack of ethics; on the contrary, it would be impolite not to do it (Kras 2001).

2.2. Knowledge Sharing from a Relational Perspective.

This research has drawn upon relevant concepts of Wenger's (2001) social theory of learning, an approach that views learning, or the acquisition of knowledge, from a relational perspective and that argues that knowledge should be viewed as being embedded in social participation. This section briefly reviews those concepts that will be later drawn upon in the analysis.

According to Wenger (2001:71), the concept of practice includes all explicit and tacit aspects. It includes what is said and what is not, what is given and what is assumed. This also includes all explicit aspects (such as symbols, contracts, documents, etc.) and implicit aspects (such as relations, non-written norms, etc). Participation, according to Wenger (2001:80), is used to describe the social experience of living in the world from the perspective of those affiliated to specific social communities and their participation in daily activities. Wenger (ibid) describes participation as a complex process that combines doing, talking, feeling and belonging. Although participation is an active process, Wenger (ibid) delimits its use to denote actors that are members of social communities.

Reification is a less known concept than participation. According to Giddens, in Wenger (2001:83), reification is the process through which societies grant properties to social phenomena. For the purposes of this research, reification has been used in a very general sense in order to refer to the process of shaping experience through the production of objects that represent such experience into a "thing". For example, drafting a law or documenting a (manufacturing) process (Wenger 2001: 84).

Conditions for community formation and learning.

Wenger (2001:99) explains that learning takes place within social communities. The elements that assist in the formation of these communities are briefly explained in the following paragraphs (Wenger 2001).

Mutual engagement is created through shared practice (Wenger 2001:100). Collaborative practice is described as that which bonds participants together. Mutual engagement is not only based on the members' capabilities, it is also based on their capacity to relate themselves meaningfully with what they do and know, and also with others' knowledge (ibid).

Joint enterprise is the end result of collective negotiation taking place during the mutual engagement process (Wenger 2001). According to Wenger (2001:105), it is the actors' negotiated answers to their context, which provides a backdrop of shared accountability between community members. In this sense, it determines the norms of accountability for shared practice between members of a community.

The third of Wenger's (2001) conditions is the construction of a *shared repertoire.* Engagement generates a series of objects in order to negotiate meaning. These resources do not have meaning by themselves until they belong to a community's practice. The community's shared repertoire includes routines, words, instruments, symbols, gestures, actions or concepts that the community has produced or adopted along the course of its existence and that have become part of their intrinsic practice.

EMPIRICAL SETTING

This research takes place in the City of Guadalajara, the second largest city in Mexico. The focus of the research is on the interactions between two small-medium sized enterprises (SMEs): FirmCo., a pseudonym, for a Guadalajara based management consulting company that began trading in March 1999, and ManCo., also pseudonym, for a manufacturing company. FirmCo. provides management consulting in areas such as sales and marketing, process redesign and the implementation of quality control systems (e.g. Six Sigma, KANBAN, TPM, 5s, etc.). ManCo. manufactures metallic forges and locks for the automobile industry. It is a subsidiary of a Spanish owned company, and has two manufacturing plants on the American continent. One is in Costa Rica, which produces and distributes products for the Central and South American markets, while the Guadalajara plant serves Mexico, USA and Canada. Most of ManCo.'s employees are Mexican, with the exception of a few senior managers who are Spanish.

FirmCo.'s general manager and co-founder claimed that in order for the firm to be a knowledge based organisation, as well as being non-hierarchical, it also needed to operate under three basic principles: theory, practice and tools. He explained this by noting that theory means having experts, who can apply their knowledge

(practice) and then 'capture' it in different 'tools' (e.g. through digitalisation) in order to better manage it and share it. He emphasised the importance of this noting:
"FirmCo. is a knowledge organisation. We acknowledge that it is one of our greatest assets and we need to learn how to manage it".

FirmCo.'s relationship with ManCo. began through a mutual acquaintance recommending FirmCo. as being experts in the area of manufacturing and quality control. ManCo. was aware that they were encountering a number of difficulties pertaining to workplace efficiency. Specifically, they wanted FirmCo. to audit their current situation and help them to better organise their activities, as noted by a ManCo.'s manger:

"What we were looking was to satisfy an increasing need to implement a methodology that offered efficiency to our workplace. That is why we decided to implement the 5s philosophy".

The 5S's is a methodology (of Japanese origin) for creating organised, clean, efficient and safe workplaces. The shared aim was to increase productivity by utilising the company's resources more efficiently and for the workplace environments to be better organised. FirmCo offered to conduct what they termed a company wide "5s programme", which comprised of different activities, the first one being a thorough audit of the different workstations. This audit would signal the issues needed to increase ManCo.'s workplace productivity. Having understood the philosophy, ManCo.'s management asked FirmCo. to prepare a proposal that detailed the intervention and implementation plan for the 5s programme.

The process of developing a business, or project, proposal consisted of a series of meetings between FirmCo.'s consultants in order to share their first impressions about the project and to analyse how it related to previous projects they had worked on (in terms of methodologies and cases). The outcome of the meeting was a 'road map' to develop the business proposal, which included the objectives of the project, the time it would take, the consultants involved, the key milestones and a price that would be acceptable to both FirmCo. and its client. The proposal was presented to ManCo.'s representatives a week later in a meeting. The head consultant prepared a PowerPoint presentation and a written document that outlined the project's key characteristics as well as other relevant information pertaining to the project. The project commenced the following day and was forecasted to be completed within two months.

The Extranet: Dot.Project.

FirmCo.'s senior management have always been keen to introduce innovations into its organisation. One of these innovations was the extranet, named Dot.Project, which was developed by one of its closest partners: TechCo. (also a pseudonym).

FirmCo.'s CEO argued there were three reasons for implementing the extranet. First, it was necessary to make all information about the current consulting project available to all parts involved, especially due to the frequency in which such projects change. According to Jergo, FirmCo.'s CEO and Co-founder:

"Consulting projects are dynamic and they usually change 'on-the-fly'. That is why we need a medium through which all parties involved stay in the loop. Experience has taught us that clients and our own consultants sometimes 'forget' the agreed modifications. Having the tool to record all this information and making it available to all parties involved is a great way for reducing 'misunderstandings'".

The second reason for introducing the extranet into the organisation was due to the high staff turnover that FirmCo. experienced during its first years, together with the hiring of independent consultants to cover projects. According to a senior manager:

"... these situations caused important information and knowledge to be lost. In other words, there was no formal system to register the process and outcome of a given project, so when consultants left the organisation they would take everything with them. We were not able to understand the life of a project".

The third reason experienced by FirmCo., and which summarises the previous two, was that senior management felt that projects could be handled more efficiently and effectively if a project's history, methods, agreements, comments, etc. were all located in one (single) electronic space, and were accessible to clients and consultants

regardless of time and location. A senior consultant also highlighted a further critical issue that related directly to the Mexican approach to work:

"There is no question that our culture towards work does affect us ... we are not prone to teamwork ... we are quite individualistic and in this business you cannot have that luxury. The extranet should help us to bring down those barriers and collaborate more ...".

Thus, he suggested that Dot.project was a way to try to compensate for the individualist work patterns in this Mexican Organisation.

The Extranet and ManCo. Project.
FirmCo. required the extranet to be used during a project's life cycle, and it was meant to be used from the time a consultant makes their first contact with a client and then throughout the tendering process. This process is administered through a customer relationship management system (CRM) that is embedded in the extranet. In ManCo.'s case, the assigned consultant registered all contacts, impressions and/or comments he had with clients. This allowed him and senior managers to review the tendering process. The extranet's functionality for FirmCo.'s senior management was (and is) key in many respects, as Jergo explained:

"Through a methodological registering of these steps, we can have a better feeling of why things went right or wrong. And then this information could be used for future reference, in case, of course, we get in contact with clients again for the same or another project".

If a tender was successful, consultants would use the extranet throughout the lifecycle of a project. For the ManCo. project, as with others, this initially involved a consultant being assigned as a project leader, who then determined different authorisation levels to his and the client's team. Once the project was "opened", the project leader registered all the tasks outlined in the proposal (in terms of money, time and person(s) responsible) together with any other observations or remarks needed to complete the project. Together with these first activities, an assigned consultant uploaded the proposal (as presented in the meeting) in a specific section within the extranet; an action that signalled the creation of the project's document library. At the same time, the project's leader opened two discussion forums: forum (A) to maintain interaction with ManCo.'s team and forum (B) to keep contact with his own team. Regarding the accessibility to these forums, forum (B) was kept private and could not be seen by clients, while forum (A) was available to FirmCo.'s and ManCo.'s team (as well as other persons such as senior managers in both organisations).

Though FirmCo.'s management believed that consultants and clients would immediately adopt the extranet without hesitation, they were surprised to find that there were difficulties adjusting to the process of using the extranet. For example, one of the first issues raised against the use of the extranet by consultants was how time consuming it was to record details about an existing or potential client. One consultant explained that this time could be better spent trying to secure a client or working on a current contract:

"We (consultants) are evaluated, and paid, according to the number of clients we bring into the organisation. If we spend time registering every movement we do, then we are loosing very valuable time. In addition to this, we are always against the time ... we need to spend time with the client not with the computer".

ManCo.'s team leader also expressed concerns over the time required to use the extranet:

"The day has only twenty-four hours and this is a very demanding business ... the fact that we need to register activities, comments, etc. in the extranet requires that we invest time. That is why we prefer to keep using traditional methods such as phone, fax, etc.".

In addition to concerns over how time consuming the use of the extranet was, one of ManCo.'s managers also highlighted three additional reasons: (i) people not trusting the technological reliability of the extranet, (ii) a practically non-existent culture regarding the use of IT; and (iii), users did not know who else was reviewing the extranet. In other words, they did not know what to 'register' in the extranet without the possibility that this may be viewed as being 'compromised' or 'impolite'.

Another sign of these difficulties was seen in ManCo., where the use of discussion forums diverged from their original purpose. For example, consultants were surprised that ManCo. generally only used the discussion forums

"to complain." The consultants were annoyed by this, as they were aware that they were also visible to FirmCo.'s senior managers. On the other hand, consultants complained visibly on forum (A) about clients not providing them with several requests (such as information about a particular process, etc.).
These issues were addressed by FirmCo.'s senior management throughout the project. Indeed, after a brief period of time, ManCo.'s team leader was very positive saying:

"I admit that we were not very fond of using the extranet. However, through working with a partner such as FirmCo. we managed to break down our own 'fear', and internal resistance. The extranet allowed us to have constant communication with FirmCo and have all information about the project very well organised and managed (such as questions, presentations, documents, etc.)."

After two months of continuous work, the implementation of the 5s project was viewed as successful by FirmCo and ManCo. In spite of the success, it is difficult to assess whether the extranet made a difference to the project.

CASE ANALYSIS

This section analyses the case described in the previous section with reference to the review of Mexican cultural values and Wenger's (2001) theory of learning, and is divided into further subsections highlighting the issues that emerged.

Trust and Commitment.

As was discussed in section two, Mexicans intrinsically do not trust others, and remain uncommitted to any collaboration until a bond of trust is established (Ibargüengoitia 1990). FirmCo.'s and ManCo.'s relations were no exception to this. In this sense, for example, given the brief time frame to implement the project and the inexistence of any previous relations, it was difficult to develop appropriate bonds of trust across both communities.

Issues of trust and commitment also affected the degree to which FirmCo.'s consultants and ManCo.'s engineers used the extranet. This was unexpected by FirmCo.'s management, who assumed that more transparency and information in a given project would be viewed positively. At the same time, they did not foresee the different use that some users made of the extranet. For example, ManCo.'s engineers used the extranet mainly to complain. In addition to this, there were also technical issues regarding the technology's stability, which created resistance and distrust in the use of the extranet. These types of situations made users more cautious about the usefulness of the extranet and caused them not to trust it.

The difficulties associated with creating bonds of trust across communities, together with a limited use of the extranet following its introduction meant that knowledge sharing did not take place until much latter in the project. This was at the point when relations had developed sufficiently for trust among some participants to be developed.

Individualism.

It is argued by academics (e.g. Rodriguez & Ramírez 1992) that the Mexican does not value teamwork. The root cause of this is attributed to the prevailing individualism associated to Mexican idiosyncrasy, in other words, the Mexican is characterised by being a 'loner', a human being that always places the individual before the community.

In the case of the relations between FirmCo. and ManCo. the concept of individualism became an intrinsic barrier for participation. For example, consultants and engineers were constantly protecting, or withholding, relevant information about the project, an issue that created information feuds within each community.
These issues were despite of the fact that consultants and engineers shared similar backgrounds in terms of their education and work experience, further highlighting how the individualistic nature of Mexicans presents a significant barrier to what Wenger (ibid) terms joint enterprise (the end result of a collective negotiation process). This resulted in limited participation within each company, and also restricted the degree of cooperation between companies to a basic level (i.e. simply doing the job). Also, each group thought more about itself than for the greater benefit of the relationship. Of course, consultants were interested in solving ManCo.'s quality problem, but only because that was their 'job'. In this sense, they were very careful of not to disclose any further information, such as tips, good practices, etc., than what was really essential. The same was true with ManCo.'s

engineers. Although they needed to solve the quality problem, they were also careful not to answer questions that would jeopardise their job or make it irrelevant.

Individualism also affected the shared repertoire developed between both teams. One example that helps to illustrate this situation is that there were many artefacts reified by each team, which shows greater integration, but there were almost none created jointly by members from both teams. This lack of shared repertoire simply states that there were limited opportunities to develop resources through which negotiate a mutual engagement. A further aspect that was influenced by the prevailing individualistic nature was how participants related to the extranet technology. Over the duration of the project there were sufficient face-to-face interactions to allow the project to continue. This resulted in staff believing that they had no need to duplicate this effort on the extranet. In fact, it was only the consulting team that uploaded to the extranet what was implicitly required, such as tasks, presentations, etc., but the activities of greater value, such as on-line discussions, were (at the beginning) almost inexistent.

This attitude definitely changed towards the end of the project due to a combination of factors. As it was noted in the case, ManCo.'s team was pleased to have the opportunity to use the extranet as it provided the opportunity to be informed of the project development and utilise these lessons in the future. Thus, with regard to this consulting project, due to individualism, the extranet did not assist in supporting collaboration and knowledge sharing to any significant extent.

Figurative Language.
A third issue that emerged in the case study is the role of figurative language. As argued by Paz in Rodríguez (2002), when the Mexican speaks it is possible to see its discretion, figures and allusions. In this sense, the argument follows, it is often impossible to discern exactly what the Mexican is thinking.
This cultural trait affected the level of participation of both groups. In the case of FirmCo., for example, consultants were always cautious in their use of words when talking to engineers in ManCo., as were ManCo.'s engineers with them. This constant 'carefulness' between both groups affected the degree of mutual engagement as they were not able to discuss clearly their views and positions, and thus never knew exactly what knowledge could be shared.

The figurative use of language, such as the telling of incomplete versions and half-truths, by both consultants and engineers also limited the degree of joint enterprise. A good example of these half-truths was when consultants asked engineers for details of how their work was carried out. Engineers were never clear or complete in their responses, or so the consultants argued. Similarly, consultant's oral presentations and written reports contained half-truths so as to ensure they were polite to the client company (ManCo.). For example, when questioned by ManCo.'s senior management about the degree of collaboration of their engineers, the consultants could not openly complain and instead they said that everything was 'perfect'.

Figurative language also influenced the use made of the extranet technology. For example, the limited use of discussions forums was due (in part) to the way comments were recorded by consultants and engineers. In this sense, as seen in one of the discussion forums, some of the comments left by engineers tried, in a very subtle manner, to invalidate the work of consultants (and vice-versa as well), and seek to discourage their future participation. On other occasions, consultants or engineers had left messages with 'good' intentions (such as feedback) but these messages were interpreted the 'wrong' way. Some commentators suggest that it is a Mexican trait to always expect to have to read between the lines to interpret the true meaning behind a message (Holms in Del Bosque 2002). However, on some occasions this was unnecessary and further limited inter-organisational knowledge sharing. The figurative use of language by the Mexican created a barrier that prevented inter-organisational knowledge sharing to fully emerge.

CONCLUSIONS

This section presents the conclusions and lessons arising from the case. Though Table 1 represents a summarised view of the findings of this research, it is possible to mention the following implications for theory and practice in relation to inter organisational knowledge sharing and Mexican SMEs. First, our analysis has highlighted that it is critical to create bonds of trust between participant communities in order to increase the use of the extranet and the commitment towards the enterprise. Second, we suggest that in this context technology was harnessed to reinforce the individualistic nature of the Mexican. This issue may be generalisable to other Mexican organisations. Further, we have highlighted that the view of language within Mexico influences the degree of on-

and-off-line interaction. In relation to future academic research, we suggest that these lessons highlight the importance of recognising that the adoption of technologies is inextricable interlinked with not only the local organisational context, but also the broader cultural values.

In terms of the conference theme, this research paper contributes to the understanding of local cultural values in the use of ICTs in order to enable economic growth in developing countries. It is the belief of the authors that ICTs are indeed an important component in the national agenda of developing countries, yet they need to understand how local values could influence these ICTs efforts.

Overall, we argue that within the Mexican context, ideas pertaining to visibility, language, and individuality and, above all, trust, are central to understanding the nature and use of technology introduced to support inter-organisational knowledge sharing.

INTER-ORGANISATIONAL Knowledge Sharing		Mexican Values		
		Trust and Commitment	Individualism	Figurative Language
	Technology Use	• Different use than originally planned • Users were cautious • No culture towards IT	• Reinforced it • Created information feuds • Face-to-face interaction increased • Limited	• Users were cautious • Withdraw from its use • Misinterpretations from both sides • Different use than originally planned
	Mutual Engagement	• Difficult to establish	• Influenced the level	• Actors were cautions • Difficulty to relate
	Joint Enterprise	• Difficult to establish	• Limited both communities participation to the simplest level	• Limited interactions • Incomplete versions, or half-truths
	Shared Repertoire	• Limited development	• Partial development	• Limited development

Table 1 – Summary of Findings.

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SESSION B6: RESEARCH PAPERS: IT & HR DEVELOPMENT IN EDUCATION AND LEARNING

Information Technology In A Developing Country: The Nigerian University Experience

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ABSTRACT

Information Technology is spreading to all areas of life but, some of the students entering Information Technology (IT) profession are not IT literate before their admission into university to study computing or IT related courses. This study investigates the reliability of the fact that majority of Information Technology or computing students are not computer literate nor have the opportunity of touching computer keyboard before entering the university. The results of the survey showed that a number of students did not use computer until they came to the university. Those that have used computer before, use it for e-mail and browsing. In Nigeria there is a need to introduce computer literacy to all secondary schools so as to bridge the gap between those that are computer literate and illiterate before admitted to the university.

Keywords: *Information Technology, Computer Literacy, Computer Keyboard*

INTRODUCTION

Information and communication technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading and writing. In the early days of computers in schools, a common rationale for the investment in hardware and software was to make students be computer literate. This concept was premised on the view that schools had a responsibility to introduce students to this emerging technology and to prepare them for the fact that one day computers might have a role to play in their daily living. As time went on, and the impact of computers in society grew, the notion of computer awareness evolved to computer literacy, not only knowing about computers but being able to use them. Throughout the 1980s the relevant literature abounds with descriptions and comment on both the rationale for such programs and evaluations of their success (McCormick, 1992).

In the last few years, computer technologies have diffused into many aspects of everyday life and in recent years this diffusion has been accelerated and exaggerated by the convergence of computer and communication technologies. The place of computer technologies in schools has evolved from objects of study or specialist applications to tools for teaching, learning and administration. Computer literacy disappeared from main gaze and focus of attention as the stand alone computer lost its novelty. But today, the concept is regaining attention as the new technologies once again gain novelty and public attention through the next phase of their development. This renewed interest appears to be fuelled by Internet and communication technologies, which are causing yet another revolution their use and growing influence of life and society.

Computer Literacy

The term computer literacy has long been used as a description of people's skills and redisposition to the use of computers and information technologies. Despite suffering a loss of reputation and popularity in recent years, *computer literacy* is still pervasive in educational literature and the concatenation of computer and literacy has come to include expectations of communication skills (Anderson & Collis, 1993). In recent years, many have argued the need for a more embracing definition for the term which assumes attributes beyond computing competency (Bigum & Green, 1992). But competencies and skills still remain the underpinning elements of computer and ICT literacy and are those that still provide the basis for explorations of the extent and scope of ICT applications and uptake among the different cohort of computer users.

The emerging use of the broader term of *ICT literacy* has at its roots the need to include more recent dimensions of technology brought about by such developments as networks and the Internet. Use of a range of communication tools such as e-mail, videoconferencing and the World Wide Web (WWW) for the location of information, and the subsequent dissemination of information are now reasonably considered to be components

of ICT literacy and yet not necessarily that of computer literacy. In addition, many of the skills, which previously had been associated with those that an individual would need to have acquired in order to be considered computer literate, are often now seen to be components of the more encompassing term of *ICT literacy.*
There have been many definitions in the past for computer literacy but all have shared common themes. Scher (1984) described computer literacy as "appropriate familiarity with technology to enable a person to live and cope in the modern world". About the same time, Hunter (1984) described computer literacy as "the skills and knowledge needed by a citizen to survive and thrive in a society that is dependent on technology for handling information and solving complex problems".

Most definitions of ICT literacy include a breakdown of the knowledge and skills of a computer literate person. These typically are categorised in ways, which facilitate some form of measurement and assessment. This breakdown often provides further insights into understandings of the terms and concepts. Simonson et al. (1987) discuss four categories as critical elements of computer literacy: computer attitudes, computer applications, computer systems, and computer programming. In contemporary views many of these elements are still present in ICT literacy although more recently, writers have moved to more functional description. What the student can demonstrate, in terms of measurable conceptual and skill development relative to computers, their uses and products, has given another direction for providing a means for assessing ICT literacy.

The Evolution to ICT Literacy

The rapid developments in communications technologies which have occurred over the past years has seen a broadening in the range of skills that are considered to be imperative to the constantly evolving notion of computer literacy. We now see a spectrum of differing expressions and terms which relate to computer literacy. For example, information technology literacy, Net literacy, digital literacy or on-line literacy (Gilster, 1997).
Overwhelmingly however more recent references in the literature still often use computer literacy as an appropriate keyword for reference listings. Definitions of computer literacy have varied in their breadth over time and with the rapid changes in technology are evolving accordingly. Where once "basic" computer literacy was narrowly defined and could be used to easily differentiate students that were deficient. Such students could be directed to specific "context free" courses to build their computer literacy.
Over the past decade, the notion of "basic" is too obscure when considering the myriad of potential contextually driven applications of computers in contemporary society. Increasingly there appear to be diverse cohorts of students, each with different bundles of computer skills, knowledge and attitudes. Students could be considered literate in one setting but illiterate in another. Many school leavers have the ability to confidently browse and use the WWW but may have little or no Database management, programming or word processing skills. The move toward the broader term of information and communication technology (ICT) literacy has at its roots the need to involve the acquiring and advantageous use of information through the use of technology. Use of a range of communication tools such as the Internet, e-mail and the World Wide Web (WWW) for the location of information and dissemination are now considered to be components of ICT literacy and yet not necessarily that of computer literacy. In addition, many of the skills, which had previously been associated with those that an individual would need to have acquired in order to be considered computer literate, are now commonly seen to be components of the more encompassing term of ICT literacy. Many authors describe the place of computer literacy as a component of a more encompassing list of ICT skills (Eisenburg & Johnson, 1996; Shapiro & Hughes, 1996).

INFORMATION TECHNOLOGY AND EDUCATION

Over the past 20 years, computers and the sharing of information that they facilitate have penetrated nearly every aspect of American Life. Indeed, reliance on computers grows every day, from shopping at grocery stores and filing taxes to driving an automobile and communicating with relatives and business associates (Johnson, KA,2000).

As the world increasingly moves toward an information society, computers and information and its use will play a leading role in this transformation. Today, one cannot talk about development without talking about computers. Computers and computer literacy are indispensable in today's information society. This underscores the need for creating a computer literate society.

Africa, the second largest continent of the globe, with a population of over 500 million, is said to be the least computerized continent. Internet connectivity is very low, and so is the man-computer density ratio (Darkwa, 1996). Nigeria has the largest population in the whole of Africa with population of over 120 million and yest

Nigeria is said to be one of the least computerized country of the world with low Internet connectivity (Inyiama, et al, 1999).

Computers are about 40 years old. Information Technology (IT) is much younger, as it is generally understood today. IT is the out growth of the microelectronics revolution and comprises; besides all shapes and sizes of computers, automation technologies and communications (Huda, 2001) In the old West, children used to learn to ride horses before they learned to walk. In the modern IT era, our children have to learn how to use the computer and other IT tools before anything else, so that they are prepared for the exponential growth of this sector. (Huda, 2001).

Building the bridge between formal education and the real world has never been so important. Students need to know exactly what knowledge is needed for what situation so that they can be prepared to face the constant and drastic changes in the corporate world. Education systems are often slow to change. Specialists in existing subjects are reluctant to give up curriculum time as pressure grows to add new subjects. While many national governments, such as that of Denmark, have for many years IT in schools a high priority, the pace of development and the need for equipment and training has often outstripped public resources. Active partnership with the private sector and other organizations is crucial. Many education establishments achieve this through closer community involvement, such as providing access to their facilities and hosting collaborative education programs(Huda,2001).

The prospects of information technology for Africa are tremendous. Nowadays it is becoming increasingly difficult to run an institution without using computers. Desktop computers are replacing traditional office typewriters. Information technology that can be used, maintained and developed by the indigenous professionals is crucial. Education and training is a key to building indigenous capacity that helps reduce dependence on developed world, to cut under-utilization of existing equipment and to help to apply technology for solving local complex problems. Though the changes for technology render what is appropriate at one time inadequate at another, African countries should consider effective use of some basic technologies. Four main technologies are very important in information access in developing countries, namely: desktop publishing, CD-ROM, on-line access and Internet connection. Indeed computers have become or are beginning to become part of everything we do. The computer is now no longer a luxury but is now becoming a necessity in order to keep up and cope with our ever-changing world and its technology. These skills need to be taught at early level to our children.

Students all enter tertiary institutions with different knowledge and information levels than that of their peers. Some enter without even been exposed to a computer before and other being exposed to computers all the time and yet they are compared and placed at the same level in higher education. This diversity and difference poses a disadvantage to many students from previously disadvantaged backgrounds. In this study, we will like know the computer literacy level of those that are coming for IT/computing profession in Nigeria.

Computer Education in Nigeria

Computer education in Nigeria started in 1963 in the IBM African Education Training Centre (UNIDO, 1989) The first degree programme in Computer Science began in 1971 in University of Ife (now Obafemi Awolowo University; the university under discussion) and by the late 1980s fourteen universities and two polytechnics had graduate/diploma programme (Commonwealth, 1988). A few years later, twenty-five universities and more than half of the polytechnic were reported to have programme. (Jaiyesimi, 1990). Despite the fact that the computing education started since 1963 in Nigeria and first degree programme in 1971, yet Nigeria is one of the countries in the whole Africa where information technology and computer literacy programme is not yet introduced in government owned secondary schools.

Information Technology in Nigeria Secondary Schools

Nigeria government had proposed introduction of computer to secondary schools since late 1990s. But because the secondary schools are many and only few are owned by the federal government, those that are owned by the federal government have computers, though the computers are not enough but those owned by state government do not have computers because of unavailability of fund.

Fund has being the major problem of Nigeria education (from Primary level to tertiary level) and the introduction of computer into secondary school will cost a lot of money, especially money to maintain the computers after purchasing them. Unless, international organizations like UNDP, World Bank, etc can come to Nigeria educational sectors aid. The situation of things in Nigeria may continue like this if solution is not found to the

problem of computer literacy. In some developed nations, IT is being used as one of the tools to alleviate poverty, though Nigerian government is trying to find solution to poverty through poverty alleviation programmes but IT which is one of the tools that alleviate poverty is uncommon in Nigeria. Majority of Nigerian are not computer literate, some that are educated are not even computer literate.

Most students entering our colleges and universities today are younger than the microcomputer, are more comfortable working on a keyboard than writing in a spiral notebook and are happier reading from computer screen than from paper in hand. But in some developing nations like Nigeria, the computer/IT literacy level is low and this study is designed to determine the computer literacy level and caliber of students entering the computer / information technology field and to determine whether the impact of previous exposure to information technology gives certain students leverage over those who have not yet been exposed to this field. At the end of this study recommendations were made on how to solve the problem.

RESEARCH METHODOLOGY

Data was collected at the Obafemi Awolowo University, Nigeria by means of questionnaires. The aims of these questionnaires were to determine the technological background of the respondents as well as the possible relation between this background and their knowledge of computers prior entering university.

The research was conducted using only second year students of Computer Science & Engineering Department of Obafemi Awolowo University, Ile-Ife, Nigeria. The students were observed in the laboratory and in the process the researchers were able to see a category of students handling computer system in a manner that shows a sense of maturity / familiarity. Personal interview was conducted in Introduction to Computer Programming class. The year two students were used in the study because at the Obafemi Awolowo University, Nigeria, year one is for preliminary science courses mainly Physics, Mathematics, and Chemistry after which the students will move to part two for core computer courses. Introduction to Computer Programming class was also used because it is the only course that involves practical in the second year in computer science & engineering department of the university.

RESULT

To evaluate the differences among students and from what backgrounds they come from and how this affects their pass rate, a survey was carried out to gauge the effectiveness of the aims, and the level of computer experience. Our sample size consisted of 113 students (which is over 90% of the students in year two) of which 66.7% of the students were aged between 18 to 25 years and 21.2% of the students were from 26 to 35 years old, and the remaining students are less than 18 years of age. The 69.7% of the responses are men while 30.3% are women. This also confirmed the claim that Men are found more in Computing profession in Nigeria (Idowu, et al, 2003).

Secondary School Attended

From figure 1 below, 46% of the students attended semi public schools (like Government secondary school, Government colleges, etc). The semi public schools are the schools owned by the government (either federal or state) and in this schools the students paid some amount of money though not as high as private schools and it is a boarding school. 30% attended public school, in this type of school students do not pay any fee. While 24% attended private school, this type of schools are owned and controlled by an individual, group of individual or an organization. The students pay in this school and the price depends on the financial capacity of the parent. The reason why majority of the students did not attend public school may be because of the poor condition of the public schools, no equipment, qualified teachers even in some situations the classrooms are bad. The thirty percent that still attended public schools are the people that could not afford to pay school fees. While some of those in semi-public and private schools are the children of either the top government officials, wealthy people and the influential ones in the society.

From the interview, these students did not have access to computer in their secondary school, those that attended government secondary school claimed that they have computer in their schools but they do not have access to the computer, though they have seen computer before and their teachers introduce them to computer and tell them part of computer and what they do.

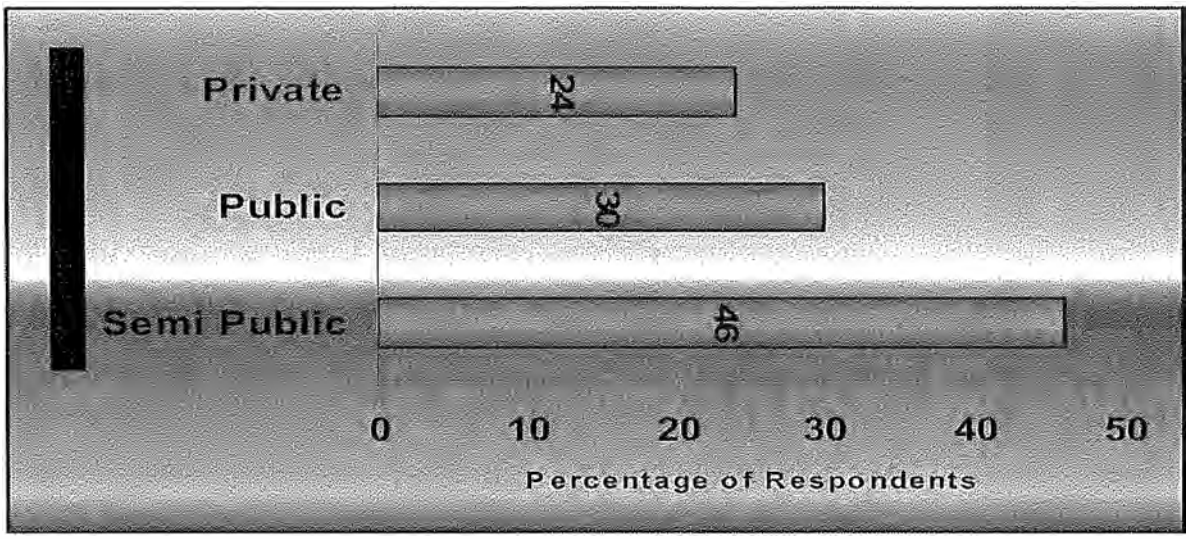

Figure 1: Percentage of Respondents that attend a particular school

Use of computer before admission into University

Only 21% of the students claimed to have used computer before coming to university to study computing while 79% never use computer before their admission into university (Figure 2). Also, one of the members of staff in the Department of Computer Science & Engineering told us that he did not have the opportunity of using computer system until he was admitted in 1992. He claimed that he did not see computer system not even where being used until 1992. He also said that he did not touch a computer until after year one when he registered for a computer training programme outside the campus during long vacation. But now that the Information Technology is spreading to every nook and cranny in all the countries of the world, why then is the fact that well over seventy percent of year two students claimed not to have had access to computer before admission into university. Despite the fact that a good number of them attended Government owned schools. This may be due to the fact that those schools did not have computers while those schools having computer system did not have teachers to teach the students.

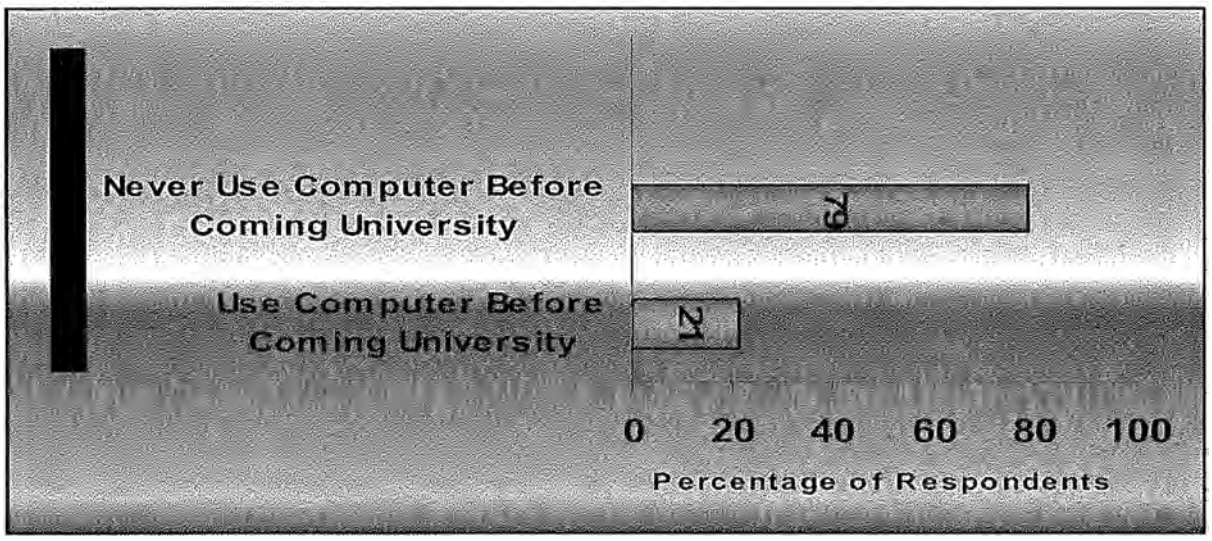

Figure 2: Percentage of Students that used computer before admission to university

Computer skills of the Students

To determine the computer skills of the students, the two practical oriented courses for year two students were used. Year two students were used because year one is for preliminary studies. 24% of the students got A (100-70)%, 32% got B(69-60)%, 25% got C (59-50)%, 8% got D (49-45%), 10% got E (44-40)% and 1% got F(39-0)% in the first course and 11% got A (100-70)%, 52% got B(69-60)%, 30% got C (59-50)%, 1% got D (49-45%), 4% got E (44-40)% and 2% got F(0-39)% in the second course as shown in figure 3. These shows that despite the fact that majority of the students did not use computer before admitted to university in Nigeria, they still coped and were able to perform in the practical courses. More than 80% of the students got 50 % and above in those courses. Though, initially in the first three weeks of the semester, practical aspect of computing and programming was taught in the laboratory and majority of the students did not perform well in the laboratory, some of them were picking keys on the keyboard, but by the second week, nearly all of them have improved. This shows that having computing background before getting to university does not matter much so far the students are ready to work.

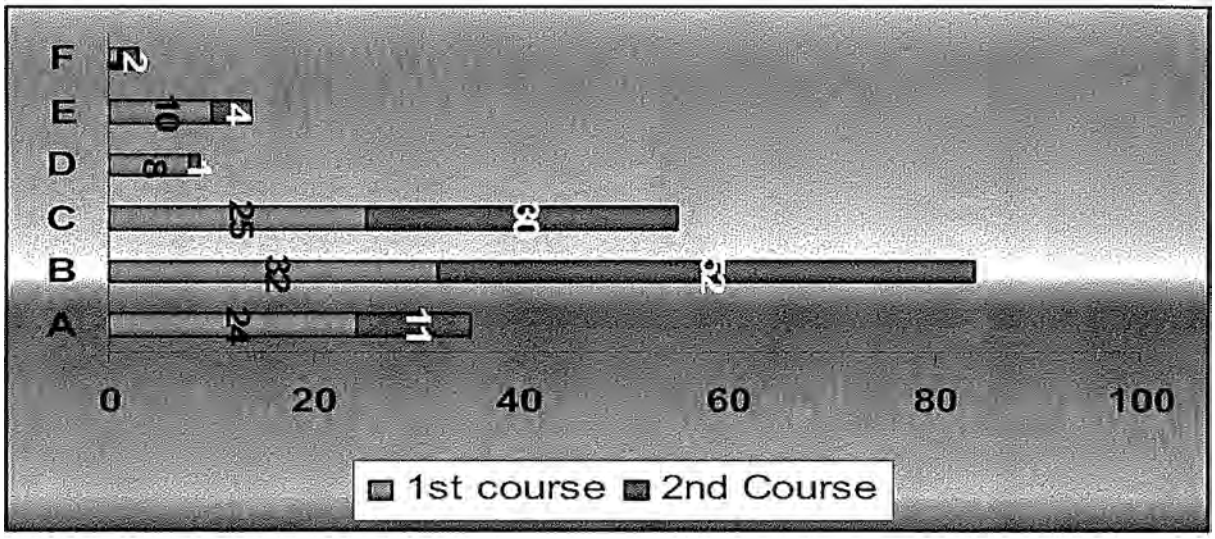

Figure 3: Students Performances in the Practical courses

Computer Experience

By the end of the second year, the students were able to run FORTRAN program and use word processing. During the course of this study, we discovered that more than 75% of those that claim to use computer before coming to university, use the system for E-mail and browsing.

Well, over ninety percent of the student claimed that they do not have computer system at home. In Nigeria, the cost of a computer system is not less than $800-$1000 which is more than a year income of average Nigerian. Only those that came from wealthy homes can have access to computer at home.

DISCUSSION

The purpose of this study was to determine the IT/Computing literacy level of fresh undergraduate students entering Computing/IT profession and to know if previous exposure to IT gives certain students leverage over those that are not exposed to computing field. The result of this study indicated that 79 percent of the students that enter Nigerian university to study IT/Computing are not exposing to the field. From the study 21 percent that claimed to be expose to computing before coming to university use computer system for e-mail and browsing, none of them use computer for data analysis, data management or programming. This confirmed Sweaney et al. (2001) that an impressive majority of participants reported at least some computer experience, with 98% having experience of word processing. Internet use was also common with 87% of students reporting that they were required to use the Internet for assignments.

Initially for the first few week of those that are not exposure to computer they did not find it very easy in the laboratory, some can not boat computer, some can not do anything with the computer. During interview in the laboratory, some of them recognized the importance of computer literacy education before their year two in the university and realize that they will have a better chance of succeeding professionally with a good knowledge of

computers before now and this confirmed Sanders and Morrison-Shetlar, (2001). Though after few weeks, the students that are at disadvantage (those that are not exposed) were able to cope, some enroll in private tutorial class/practical class so as to be able to meet up with their colleagues. By the end of second semester, they are familiar with computer and keyboards. Our study confirmed that majority of Nigerian students coming to Nigerian universities for Computing/It related courses are not computer literate, though at the end of their second year majority of them have really improved and they can use computer for word processing, E-mail, browsing and programming.

CONCLUSION

Over the past decade, the notion of "basic" is too obscure when considering the myriad of potential contextually driven applications of computers in contemporary society. Increasingly there appear to be diverse cohorts of students, each with different bundles of computer skills, knowledge and attitudes. Students could be considered literate in one setting but illiterate in another. Many school leavers have the ability to confidently send and receive e-mail and browse but may have little or no knowledge of programming or word processing skills. Bradlow et al. (2002) suggest that in addition to increased computer experience at an earlier age, this trend can also be attributed to the advances in software and computing power which have made computers more users friendly. It may be that a lower level of knowledge is now required to successfully utilize computer applications. The results of the survey showed that a number of students did not use a computer until they came to the university. Those that have used compute before use it for e-mail and browsing. In Nigeria there is a need to introduce computer literacy to all secondary school. We therefore recommend that Nigerian government should introduce computer literacy programme into public primary and secondary schools. Also a bridging course in computer literacy should be introduced into Nigerian universities, whereby students can be introduce to computer fundamental and a programming language like BASIC programming language in the year one . Though in some universities in Nigeria, computer literacy courses were designed for all the undergraduate students so that they can be computer literate, but some of the students did not have access to computer, so Nigerian government should provide computers for schools so that all Nigerian students can be computer literate, especially in this era of online/electronic learning. This study is only applicable to Obafemi Awolowo University, Ile-Ife, Nigeria, but we want to believe that if the same study is carried out in any other university in Nigeria, it will definitely be the same because the students used in the study were from different schools from different parts of the country. Although in order to better ascertain conclusions, further research should be conducted using other universities.

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Risk Identification and Management in Information Systems Development Projects within the Nigerian University Environments: An Empirical Study

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ABSTRACT

This paper reports the identification and management of risks associated with developing information systems (IS) within the university environment in Nigeria. The study uses interview and a variation of the Delphi method in eliciting the viewpoints of top IS project managers. The result indicates that socio-economic and organisational related risk items are considered inimical to the success of the IS project. Particularly, top management commitment ranked as the most critical factor needed for a successful IS project within the setup; the absence of which led the study's participants to ascribe the IS project as "partial success". Further, the uncovered risk items, ordered by priority could be used as checklist by other practitioners. Insights of the counter-measures used to ameliorate some of the risk items were also gained. This may be useful for other entities in similar settings. The study presents its implications with regard to the human resource development and IS project management for the country.

Keywords: Information Systems Development, Risks, University, Risk Management, Nigeria

1. INTRODUCTION

Many tertiary institutions in Africa are increasingly taking on new opportunities presented by information and communication technologies (ICT) as they improve both the quantity and quality of education on the continent (Ajayi, 2003; Brown, 2002; Uwadia et al., 2002; Darkwa and Eskow, 2000). Some information systems (IS) projects within the education sector of countries in Africa reported in the literature include the African Virtual University (AVU) project (Darkwa and Mazibuko, 2000; Ajayi, 2003), the Nigerian University Network (NUNet) project (Nwamarah, 2002; Ifinedo, 2004) and WebCT adoption in a South African university (Brown, 2002). In similar vein, pan-African collaborative ventures involving the use of ICT within the higher-education environment and related areas, is growing. For examples, the Cooperative Information Network Linking Scientists, Educators, Professionals and Decision Makers (COPINE), Education for Development of Democracy Initiative (EDDI), Association of African Universities (AAU) databases, to mention but a few (see, Ajayi, 2003).

As these information systems development (ISD) projects are initiated and implemented, it goes without saying that there are risks every step of the way. To this end, in this paper, we have made an attempt to present the sorts of risk that are encountered as one of such ISD projects within higher learning environment in Nigeria are executed. The selected ISD project chosen in this study is the Nigerian Universities Management Information Systems (NUMIS) software project. In particular, this study reports the identification of the risk factors in that project using the Delphi method. Furthermore, the counter-measures taken by the top project managers of the project in attenuating the negative impact of the uncovered risks, is discussed. The justification of using the education (tertiary) environment in this study is informed by the import attached to this sector as many African developing countries (DCs) make effort to shake off the yoke of underdevelopment (see, Sachs and Warner, 1997; Castells, 1999). Likewise, the national information technology (IT) policy in Nigeria acknowledges the role of IT in its educational sector (NITDA, 2001; NITDA, 2002). More importantly, education came in second only to "Health" on the list of priorities that ICT could be applied to enhance sustainable development in Africa (see, Gokhale, 2001; EJS report, 1992).

Furthermore, tertiary institutions all over the world including those in Africa spend huge sums on the procurement and development of much needed IS functions (Lund, 1998; Fielden, 1998; Ifinedo and Uwadia, 2005). Such IS/IT systems are used for improving services for the various stakeholders in the university environment. Services provided by such IS include student admission processes, financial aid processing, student academic transcripts and records, staff payroll, web-based teaching and learning support and many more. Generally speaking, such higher-learning based IS projects can be viewed from the wider lens of issues relating to information systems development (ISD) and their success/failure factors (Boehm, 1991; Lucas, 1981). For many years, several researchers from the developed world have investigated various approaches aimed at improving the success rates of IS projects and at the same time, seek measures to decrease the incidents of failures. Exemplary approaches cited in the IS domain include the Critical Success Factors (Rockart, 1979) and Risk Management Theory (Alter and Ginzberg, 1979; Charette, 1989; Boehm, 1991; Schmidt et al., 2001). Regardless of which approach is used, identifying the risk factors in any project is the first step in successfully managing and attenuating the impact of risks to that project.

Sadly, studies have shown that up to 90% of all IS projects fail to meet their goals (Clegg et al., 1997). Similarly, Ward (1994) provides information regarding chronic occurrences in systems developments where up to 25% of large projects got cancelled, 60% experienced cost overruns, 75% had quality problems and less than 1% of all the systems developments projects studied met schedule. A majority of IS project are late, cost overruns or escalation is very common and in some other instances the IS projects are cancelled (Ewusi-Mensah and Przasnyski, 1994, 1995; von, Genuchten, 1991; Standish Group, 2001; Clegg et al., 1997). Keil et al. (1998) write, "One explanation for the high failure rate is that managers are not taking prudent measures to assess and manage the risks involved in these projects". Specifically, on the African continent, the fact appears to be the same; even though, the level of surveys, evaluation and analysis from the continent is scarce. However, a few cases of IS project failures in Africa have been discussed by (Heeks, 2002a); therein, he classified them as *partial* success and *total* failures stories. The examples he cited include the land licensing IS project that was abandoned as soon as it is being implemented; the IS project that involves the creation of touch-screen kiosks in rural communities in South Africa, which succeeds partially. This type of IS project failure is described by Heeks as "sustainability failure" – an initiative that first succeeds but is abandoned soon after. Other researchers of IT/IS projects in Africa including Moussa and Schware (1992) conclude on the basis of available facts that most World Bank-funded IT projects in Africa were prone to sustainability failures. Likewise, in the West African sub-region, total failures of IS/IT projects are exemplified by: 1) Tettey (2002) that discussed the development and implementation of Accounts and Personnel computerisation in Ghana's Volta River Authority, where a group of workers resisted the use of the new IS, which led to its abandonment, 2) the issuance of national identity cards to Nigerians, which was conceived in 1978, the implementation phase started in 1982, stalled and resuscitated. The first issuance was slated for 2003; hitherto, only a handful of Nigerians have the documentation. The failure of the Nigerian ID project is attributed to poor IS project management and lack of executive support (see, Nigerian businessinfo.com, 2003).

1.1 Implementation of IS projects within University Environments

The implementation of IS projects within university environment is not free of risks and uncertainties. In fact, several researchers in the developed countries have documented instances where a variety of risks and uncertainties are reported to plague the development and implementation of IS projects within the university ambience. For example, the sort of problems encountered in deploying enterprise resource planning (ERP) systems in Cleveland State University, USA is one example (Stedman, 1999). Other cases include those by Davidson and Burrow (1990), Sieber et al. (1999) and Walko (1999). By the same token, some United Kingdom's researchers have come up with a framework for managing IS projects in higher education (Anonymous, 2002). Realistically, such an effort might have been conceived in the context of that society – highly developed. However, it may be worthwhile to argue that using such a framework for regions whose ISD project risk factors (including those peculiar to higher-learning environment) have not been adequately researched may bring no good at all. Sadly, very limited information exists with regard to the sorts of risks that might be encountered in the course of developing IS projects within university setups in the developing world. The contributions of the few literature in the IS field discussing risk factors identification in software companies in Nigeria, is noteworthy (see, Mursu et al., 2000, 2003). With regard to the university environment in Nigeria, Nwamarah (2002) asserts that lack of fund, lack of commitment by university administrators, lack of infrastructure are some of the constraints responsible for the slow development of computer networks in Nigerian universities. NITDA (2002) report, echoes similar sentiment.

Therefore, this study is aimed at shedding more light on the discourse by identifying the risks and uncertainties that may impact negatively upon ISD projects within the university environment in Nigeria, which invariably may have implications for practice and research. To that end, this paper sets out to identify the risks that might be encountered in the course of developing IS systems within a higher-learning (university) environment. Notably, the objectives of this paper are threefold: What are the risk factors associated with ISD projects within university environments in Nigeria? Which risk factors are critical and which ones are less important? In regard of the critical ones, why are they considered critical and what measures are taken to lessen their impacts on the ISD project selected for this study. The rest of the paper is organised as follows: Firstly, a literature review of ISD project risk factors is presented. Secondly, an overview of IT use in Nigerian universities is discussed. Thirdly, the research settings and method are discussed. Lastly, the results and conclusion sections are presented.

2. LITERATURE REVIEW

It is important to note that there are inherent difficulties in managing ISD projects, whether such systems are located in a university setting or not. This is because ISD projects are fraught with uncertainties and risks (Alter and Ginzberg, 1978; Zmud, 1980; Beath, 1983; Nidumolu, 1995) and in serious instances failure is the inevitable outcome (Ewusi-Mensah and Przasnyski, 1994, 1995; Lyytinen, 1988; Lyytinen and Hirschheim, 1987) when such project risk items or factors are not properly or successfully managed (Boehm, 1991; Lyytinen, 1988; Charette, 1989, 1996). Numerous accounts in extant IS and other trade literature give account of failures of information systems, globally (Lyytinen and Robey, 1999; Drummond, 1996). Some researchers have; however, cautioned that the thrust of IS research into failed ISD projects should not aim at seeing such failed projects as embarrassing incidents, rather as opportunities from which useful lessons could emerge (Abdel-Hamid and Madnick, 1990; Ewusi-Mensah and Przasnyski, 1995; Heeks, 2002b).

To begin with, our notion of a successful ISD project is one in which a particular ISD project meets its set objectives and goals, cost escalations is minimal and/or manageable, end-users' satisfaction and management support gained, to mention but a few. Conversely, a failed ISD project refers to an initiative where stakeholders experience significant undesirable outcomes (Heeks, 2002b; Lyytinen, 1988; Standish Group, 2001). The afore-mentioned items/factors mentioned are some parameters by which any project's success or failure tales are recounted.

Nonetheless, in the face of numerous research on risk factors in ISD, coupled with rapid progress in project management and the use of modern tools and techniques in IS project management, IS projects still continue to generate mixed results – sometimes favourable and at times not. It is sad to note that more negative statistics abound as was indicated above. To militate against the ugly trend or fact, several studies in ISD project risk management have surfaced. And, possible remedies have been advanced, some of such include the use of risk management techniques, effective coordination, formal planning, management skills, users' participation, project management tools, the need to learn from post-mortems of failed projects, and many more (Fairley, 1994; Land and Somogyi, 1987; Ewusi-Mensah, K. and Przasnyski, 1995; Barki et al., 2001; Nidumolu, 1995; Beath, 1983). Essentially, IS researchers have identified several risk factors impacting negatively upon the success of ISD projects (Alter and Ginzberg, 1978; Lyytinen, 1988; Lucas, 1981; Ropponen and Lyytinen, 2000; Flowers, 1996; Barki et al., 2001; Boehm, 1991; Moynihan, 1997; Barki et al.; 1993). Such risk factors are wide-ranging; and, in fact IS literature tends to differ on taxonomical arrangements, to the extent that such risk factors come under multifarious classifications. Proposed classifications of risk factors in ISD and software development projects include those of the following researchers: (Barki et al., 1993; Keil et al., 1998; Schmidt et al., 2001; Barki et al., 2001; Willcocks and Margetts, 1994; Kemerer and Sosa, 1991; McFarlan, 1982; Fairley, 1994; Lucas, 1981; Zmud, 1979). Regardless, the definition of risks and uncertainties in the IS domain seem to have a uniform connotation (Barki et al., 1993); thus this paper utilises risk definition from the work of Ropponen and Lyytinen 2000) wherein, a risk item is said to denote a particular aspect or property of a development task, process, or environment, which if ignored, will increase the likelihood of a project failure. Other definitions of risk amongst others refer to a condition that can cause threats to the finishing of a software development or an ISD project (March and Shapira, 1987). Barki et al. (1993) explain project development risk by constructing a mathematical equation relating uncertainty associated with the project and the magnitude of potential loss with the project failure.

Further, ISD refers to the process by which information-technological processes facilitate work activity through the specification, analysis, design and implementation of information systems (Hirschheim et. al, 1995). Of note, this study chooses to report ISD project risks along the patterns and refinements offered by Schmidt et al. (2001), which to a large extent, compares with other mentioned researchers' classifications. The Schmidt et al. (2001)

risk items name list is chosen for the reasons of simplicity and understandability. Although, the Schmidt et al. list has 14 main risk group sources, ours has 6 main categories; namely:

Project management (PM): Examples – lack of effective project management skills and so on.
Organisational/business environment (OB) risks: Examples – lack of top management commitment and support, unstable environment, politicking etc.
External dependencies (EX) risks: Examples – Inadequate support from local vendors etc.
Technical (T) risks: Examples – lack of the required IT skills/knowledge in the team, etc.
Resource/financial constraints (RF) risks: Examples – lack of funding and/or huge capital.
Socio-economic context (SE) risks: Examples – irregular power supply, poor infrastructure, etc.

Moreover, this classification compares somewhat with the "Information, Technology, Processes, Objectives, Staffing and skills, Management and Other resources (ITPOSMO) checklist of (Heek's 2002b), which was formulated from previous work regarding computerisation and IT development in the DCs (see for example; Ojo, 1996; Bhatnagar, 1990 and Lind 1991). In general, several risk factors are associated with IS project development and implementation, a few of the widely discussed ones are presented in Table 1 below. See the work of Wallace and Keil (2004) and Barki et al. (1993) for a more comprehensive list.

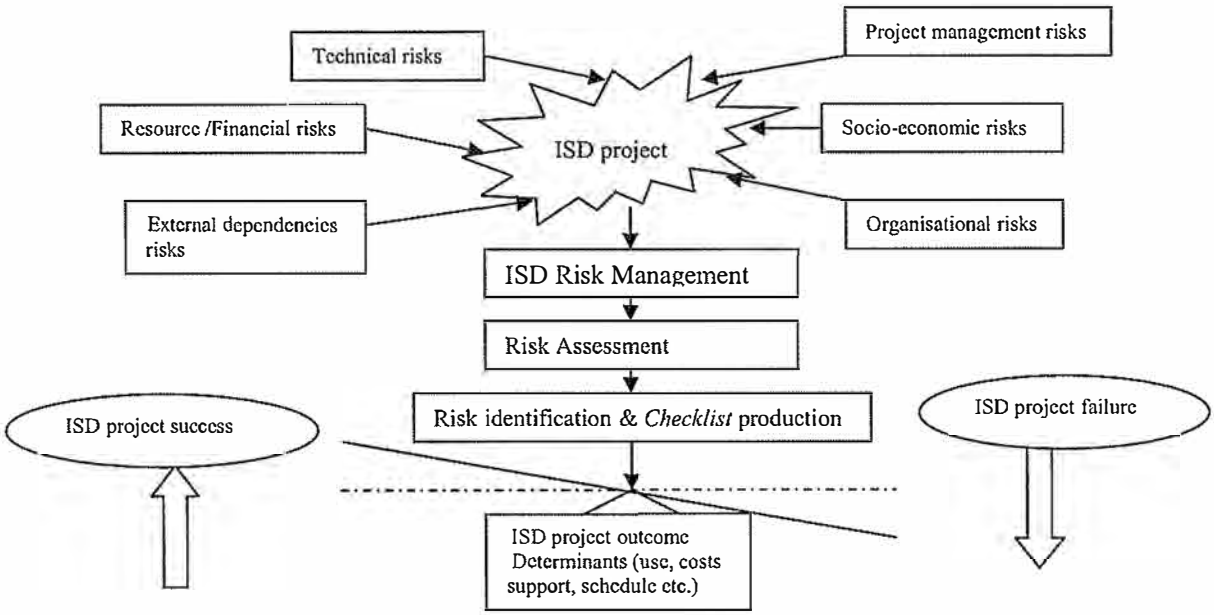
Table 1: Information Systems Developments Risk Factors

Risk Item/Factor	Risk Group	References
Unclear/Misunderstood scope	PM	Keil et al., (1998), Standish Group (2001)
IT illiteracy among users	SE	Ojo, 1996; Odedra et al., 1993
Resistance to change	OB	Tettey, 2002; Ojo, 1996
No or inadequate Planning	PM	Standish Group (2001), Lucas (1981)
Misunderstanding the requirements	PM	Standish Group (2001), Clegg et al., 1997
Irregular energy supply	SE	Mursu et al. 2000, 2003; Ojo, 1996
Lack of required IS skills in team	T	Alter (1979), Al-Wohaibi et al. (2002)
Changing requirement/scope	PM	Schmidt et al., (2001), Keil et al., (1998)
Lack/ insufficient of funding	RF	Mursu et al. (2003), Barki et al. (1993)
Lack of effective PM skills	PM	Land and Somogyi, 1987, Standish G. 2001)
Wrong development strategy	PM	Standish Group (2001), Alloway (1976)
Insufficient / inappropriate staffing	T	Keil et al., (1998), Standish Group (2001)
Artificial deadlines	PM	Standish Group (2001), Boehm (1989)
Lack of users' involvement	OB	Beath (1983), Robey et al. 1989
Poor control of project	PM	Boehm (1989), Standish Group (2001)
End-users' expectations	OB	Keil et al., (1998), Beath (1983)
Control over ext. vendors	EX	Boehm (1989), Wallace and Keil (2004)
Frequent conflicts among team	PM	Flowers (1996), Casher (1984)
Unstable Org. environment	OB	Wallace and Keil, (2004)
Lack of top management support	OB	Beath (1983), Schmidt et al., (2001)
Lack of "people skills" management	OB	Schmidt et al., (2001), Keil et al., (1998)
Lack of frozen requirements	PM/OB	Keil et al. (1998), Standish Group (2001)
Conflicts between departments	OB/PM	Robey et al. (1989), Casher (1984)
Inadequate users' training	OB	McFarlan (1981), Jiang and Klein (2001)
Complexity of the project	T	Zmud (1980), Beath (1983)
Failure to gain users' commitment	OB/PM	Beath (1983), Barki et al. (1993)
Inadequate support from vendors	EX	Boehm (1989), Barki et al. (1993)
Introduction of new technology	T	Barki et al. (1993), McFarlan (1981)
IT illiteracy among top management	SE	Ojo, 1996; Mursu et al., 2000; 2003

All the risk factors group above, with the exception of the socio-economic (SE) related risks are known and widely covered by several researchers in the developed countries; however, recently, a study on the nature of risks in software development projects in Nigeria uncovered a new set of risk items, which hitherto have not been noted by IS research in the developed world (see, Mursu et al., 2003). That said, the avoidance or reduction of the impact of risks, especially those that can be managed or controlled in ISD projects has commanded prominent positions in IS discourse, in which *risk assessment* and *risk control* (Casher, 1984) are the two main phases (Boehm,1991). The sub-categorisation of those two phases covers areas such as risk identification,

analysis, resolution and so on (see, Boehm, 1991). Thus, this study deals with the identification of ISD project risks within higher-learning (university) environments in Nigeria with the understanding that the knowledge and discovery of the risk factors may somewhat enhance and increase the success rate of IS projects development in Nigerian Universities. See the illustration in Figure 1 below.

Figure 1: The framework for risk groups, ISD management phases and outcomes



3. OVERVIEW OF IT USE IN NIGERIAN UNIVERSITIES

Nigeria is a Sub-Saharan African country. In terms of socio-economic indicators, Nigeria is a poor country (CIA World Fact, 2004). IT use in Nigeria is just beginning to spread, against the backdrop of serious socio-economic constraints (Ojo, 1996), though the diffusion of ICT in banks, foreign multinationals and governmental establishment is much higher in comparison with other sectors of the economy (Tiamiyu, 2000). Serious limitations are noticeable with respect to the diffusion and use of IT in Nigerian universities (Uwadia et al., 2002; Nwamarah, 2002). For example, the NITDA (2002) report notes that "About 90% of colleges/universities in Nigeria are without Internet connections while less than 2% have Internet bandwidth of about 64kbps". Nwamarah (2002) paints a gloomier picture with his question, "How could one single personal computer be used for entering students' data in a university with a population of over 10,000 students?" Despite these teething problems, many universities in Nigeria especially the private ones have been able to make remarkable progress in their bid to computerise their operations. Equally, public universities have made commendable effort in inter-university IS collaborations and projects (Uwadia et al., 2002).The NUNet project is one of such in Nigeria (Ajayi, 2003).

4. RESEARCH CONTEXT AND SETTINGS

4.1. Research Method

This study used an integrative approach in which the interview approach and a variation of the Delphi method (Kendall, 1977; Schmidt, 1997) were used in eliciting viewpoints of participants. The Delphi method stopped after the first round for two reasons: 1) Assurance of further participation was becoming difficult and 2) and a good concordance value of more than 0.5 has been reached. Basically, the Kendall's W coefficient of concordance is anchored thus; 0 (no agreement) and 1 (total agreement). However, there is a note of caution, which Mursu et al. (2003) sounded as they write "...it should be observed that a high or significant value of W does not mean that the orderings observed are true representations of the level of consensus". Moreover, the advantages of the Delphi method include its inexpensive nature and ease of use; its encouragement of reflections and consensus among expert panel. At the outset, the panelists were interviewed using the telephone and email in eliciting the risk factors. Essentially, the participants were asked to enumerate risk factors impacting negatively upon their ISD project. This stage is akin to brainstorming sessions in similar work, see (Schmidt, et

al., 2000; Mursu et al., 2003). The participants were given the freedom of naming 6 – 7 risk factors based on their experiences and encounters in their job/tasks in the course of developing IS projects within the university environment. At first, five panelists agreed to participate in the study. 33 risk factors were mentioned with agreement on 9 items. One panelist dropped off citing work pressures. After collation, the uncovered risk factors got delineated - where possible – according to the risk factors/items used by (Schmidt et al., 2000), which other similar work (Mursu et al., 2003) have also used. Some of the risk items were merged. The final list given to the expert panel to rank and rate has 29 risk factors. The participants were asked to rank the risk factors from the most negative factor (**1**) to the success of their university-based ISD project(s) to the least significant risk factor (**29**). Another part of the questionnaire has the same risk factors, which the panelists rated. The response options were anchored on a seven-point Likert-type scale, ranging from "very serious and negative" (7) through "moderate" (4) to "of little significance" (1), for the success of the ISD project. See Table 3. for the results. SPSS 10.0 software was used in performing the relevant statistical analysis. Finally, separate interview was conducted with each participant wherein each panelist was asked to comment on the topmost risk items, as ordered by panelists' ranking.

4.2. Demographic Profile

Four influential individuals – at the top managerial level in the project - with several years of experience in IT project management participated keenly in the study. The average years in IT and project management for the participants is about 21 years. Their demographic information is provided in Table 2 below.

Table 2: Participants' Demographic Profile

Age	Mean: 48 years
Gender	Male: 100%
Job Title	Director: (3): 75% IT Consultant (1): 25%
Education	Bachelor's (1); Master's (2); Doctorate: (1)

4.3. The Research Settings

Our panel participated in the Nigerian Universities Management Information Systems (NUMIS) software project. The project is funded by the Nigerian government, through the National Universities Commission (NUC) and supported with funds from the Overseas Development Administration (ODA), through the British Council. The project's scope covers requirement analysis and specification, design, coding, and deployment of the software solution to handle students, staff, and financial records of six pilot universities in Nigeria. They include the universities of Lagos, Jos, Ilorin and the University of Nigeria, Nsukka amongst others. Upon completion of the initial phase with pilot universities, seventeen (17) other universities in the country have since deployed the software. The project cost is estimated at US$250,000. The project duration was for five years (1990 – 1995); however, maintenance activities are on-going. Also, some universities are extending the software's capability. Importantly, five Directors – from the six pilot universities - were contacted to participate in this study; one Director participated at the early stages of the study and couldn't continue any further, three others participated fully and the fourth was a consultant.

5. RESULTS AND DISCUSSIONS

The Kendall's *W* coefficient of concordance for our participants is **0.599**, which is an acceptable value for this kind of study (Schmidt, et al., 2000). See Table 3 below for summary of the risk factors' relative rankings and ratings.

Table 3: Ranking and the Relative Importance of Risk Factors the Nigerian IS Project

Risk Item / Factor	Risk Group		Mean	Rate (Average) / Standard dev.
Lack of commitment from top university administrators	OB		1.75	(5.75) 1.89
Resistance to change from some quarters	OB		3.50	(6) / .82
IT illiteracy among top management	SE		4.00	(6.25) / .96
Lack of funds / Insufficient financial resource	RF		4.75	(5.75) / .96
Unstable environment (closures, strikes etc.)	OB		7.50	(5.75) / 1.89
IT illiteracy amongst users	SE		7.75	(5) / 1.63
Lack of "people skills" management	PM		11.25	(4.75) / .50
Failure to gain users' commitment	OB		11.50	(5) / 2.16
Insufficient or inappropriate IT staffing	T		12.25	(5.75) / .50
Complexity of the IS project	T		13.00	(2.75) / .96
Unclear or misunderstood scope of project objectives	PM		13.25	(6) / .82
Irregular energy supply (NEPA *factor*)	SE		13.75	(6) / .82
Trying new technology/method by crashing the "old" system midway	T		14.50	(6) / .82
Sabotage by disgruntled personnel	OB		15.00	(7) / .00
Inadequate users' training	OB		15.50	(5) / .82
Lack of infrastructure (telephones, IT books etc.)	SE		16.25	(5.75) /.50
Artificial deadlines (unrealistic deadlines)	PM		16.75	(4) 1.41
Too much emphasis on monetary returns for the systems	RF		17.00	(4.75) / 1.26
Political interferences in the IS project	OB		17.00	(6) / .82
Lack of required IT skills in the development team	T		18.75	(4.75) / 2.63
Misunderstanding users' needs / requirements	PM		19.00	(6.75) / .50
Inadequate or unavailability of hardware and software (platforms) support from local vendors	EX		19.50	(5) / 1.41
No planning or inadequate planning	PM		20.75	(5) 1.41
Lack of effective project management skills	PM		21.75	(5.50) / 1.29
Wrong development strategy (e.g. prototyping etc.) and/or lack of understanding of alternative technical methods	PM		23.00	(5.25) / .50
Lack of user's involvement during IS development	OB		23.50	(5) / 2.16
Changing requirements, scope and objectives	PM		23.50	(5) / .82
Frequent conflicts among development team	OB/PM		24.50	(6) / 1.41
Poor/non-existent control of project	PM		24.50	(6) / .82

By using the top-ten (top-10) risks (see, Boehm, 199), the identification of the risk factors in the development of IS projects within the Nigerian university environment have the following items as the most serious and significant items that may impair the success of the ISD project: *Lack of commitment from top administrators, resistance to change, IT illiteracy among top management, insufficient funding* and so on. Overall, a majority of this risk items are organisational and socio-economic related risk items according to our classification. This finding is consistent with previous research relating to IT/IS implementation and development in DCs (Mursu et al., 2000, 2003; Ojo, 1996; Bada, 2000; Ifinedo and Uwadia, submitted; Al-Wohaibi et al., 2002; Heeks, 2000b; Tettey, 2002; Ehikhamenor, 2002). Technical related risks (Mursu et al., 2000; Odedra et al., 1993) also featured in the top-10 risk items. Relatedly, the top-10 risk factors rated "serious and negative (5)" and above for the IS project success, with exception of the tenth risk factor by relative ranking - complexity of the IS project - which was averagely rated as having "less significance" to determining the success of the project. This, mirrors the

findings of (Keil et al, 1998) where IS/IT project managers from the developed nations view risk assessment involving technology as being fully understood and less likely to constitute a risk, per se. Furthermore, all other items rated highly supporting opinions garnered through the interview with the participants. There was uniformity on the risk item of "sabotage", which some panelists associated with resistance. Ojo (1996) has discussed, to some extent, such issues in regard of the Nigerian society and the lack of cooperation amongst universities dons in the country, in particular.

Realistically, *top management commitment and support* has been found to be of critical import to the success of ISD projects (Lucas, 1981; Beath, 1983; Schmidt et al., 2001; Ewusi-Mensah and Przasnyski, 1995; Newman and Sabherwal, 2001). In fact, it is the most important risk factor among the set of risks that (Keil et al. 1998) contend as having universal relevance. In this study, it ranked topmost and equally rated highly as a factor that could impeded the success of the NUMIS project. Also, (Ojo, 1996) and (Tettey, 2002) have both discussed the issues of *resistance to change* in the course of implementing IS in DCs. Likewise, the *lack of IT awareness* in has been noted by several researchers (Mursu et al., 2000; 2003; Odedra et al.. 1993; Al-Wohaibi et al., 2002; Heeks, 2000b). The *unstable environment* particularly in regard of stoppages in academic calendars caused by students' unrest and lecturers strike, rated as a risk factor in developing ISD project within the university environment. Incidentally, this is an example of the sorts of social problems that could cause IS projects to be abandoned or fail (Ewusi-Mensah and Przasnyski, 1994, Bada, 2000). Needless to say that overall *level of IT skills* in the country may hamper the usage of IT/IS, which may affect the success of the IS projects (Odedra et al., 1993; Ojo, 1996; Mursu et al., 2000; Ehikhamenor, 2002; Ifinedo, 2004; Ifinedo and Uwadia, 2005). In the same vein, the required *skills for effective project management* are limited in the country (Ojo, 1996; Mursu et al., 2000, Ifinedo and Uwadia, 2005). Thus, *gaining users' commitment* in this particular project may be less forthcoming as a result of the reasons discussed above – resistance to change or lack of necessary IT skills. The last two risks items on the top-10 risk factor are *insufficient or inappropriate staffing* and the *complexity of the IS project. Insufficient or inappropriate staffing* as a factor also was among the set of risk items that were purported to have universal relevance (Keil et al., 1998). In the case of a developing country like Nigeria, this is even dire (Mursu et al., 2003; Ojo, 1996; Odedra et al., 1993; Heeks, 2000b). As a direct result, it wouldn't be surprising to observe that the complexity of IS projects being mentioned, rated and ranked highly as a risk factor. Al-Wohaibi et al. (2002) finds this item to be of relevance in another developing country - Oman.

Further, the moderate level risk factors for the NUMIS project include the following: *Unclear or misunderstood project objectives, irregular power supply, trying out new technology in the course of the project, political interference* on the project, amongst others. In terms of the risk group classification, risk items relating to project management, technical and organisational are noticeable here. And, for the risk factors that ranked relatively lowly, those include items relating to dependencies on *external entities (vendors), no or poor planning, lack of effective project management skills, wrong development strategies* amongst others. Interestingly, with regard to misunderstanding users' requirements, our finding is dissimilar with that of Mursu et al. 2003, where this item ranked highest. One reason is that this particular project has clearly defined requirements and scope (Uwadia et al., 2002; Ifinedo and Uwadia, 2005); as such, the uncertainties resulting from those risks may be expected to be minimal. Another reason may be the experience level and positions of the participants used in this study. For the same reasoning, the risks associated with mainly project management and external dependencies were considered to be less inimical to the success of the NUMIS project. This does not, in any way detract from the generic issues relating to lack of technical and project management skills for IS project in DCs.

5.1 The Management of the Critical Risk Items in the NUMIS Project

Some of the directors of the NUMIS project that participated in this study also shed light in interviews as to why the items that ranked highly were considered critical to the success of the project. They were also asked to comment on the measures taken to ameliorate the effect of such risk factor. Their responses are discussed thus: First and foremost, role of the top administrators in approving and controlling the finances of the project was highlighted. One Director remarks "...their [top administrators] lack of interest in the project stall the project". The measure taken to lessen this risk includes involving them in the project committees and selling them the benefits of the project. On the issue of resistance, the Directors concurred that this will create bottlenecks and hindrances to ISD project. The counter-measures taken by them include: Involving key personnel in the project, training and providing awareness to such entities by making them to see how the IS project could enhance performance.

Our participants also agreed that because of the IT illiteracy among top administrators, project appreciation suffers. Resistance develops, hence priorities shifted elsewhere. The specific measures taken to lessen the impart

of this risk was to provide the top functionaries with computers, provide attractive overseas training for them as well as organising senior management IT training locally. Further, the lack of fund or insufficient financial resources as a risk factor made one Director to remark as follows: "This will kill a project even before it takes off!" In particular, the strategies taken to ameliorate this risk item were to encourage all the participating institutions in the project to make and honour resource contributions – financial and otherwise. Additionally, external sources of financing from donor agencies such as the British Council and USAID were sought.

The unstable environment characterised by closures and unrests, in the words of one Director, "... negatively affect project development and implementation schedules as well as cost estimations." The Directors asserted that this problem was tackled by working outside the university calendar, meetings and development activities took place outside university environments. On the "IT illiteracy among users", they said that this shortcoming will result in genuine effort being less appreciated, and the abandonment of the ISD project in the long term. The remedies used amongst others include the provision of training, involving the users in the development activity. Skills auditing and assessment was conducted prior to staffing of the project as a measure for combating the risk of "lack of people skills management". The project could suffer when such is not properly attended to, is a sentiment shared by all of them. The inability to gain users commitment was agreed to as one factor that could "kill and cause a project to be abandoned" in the words of one Director. To overcome such, one Director notes, "... they [users] were made part of the project right from the onset" and another adds "Users were sensitized and sold the benefit of the project."

Project failure occasioned by late delivery that could lead to loss of confidence on the part of the user, reverberated among the participants when "insufficient/inappropriate staffing", exists. The solution used therein included the auditing of skills in the pilot universities in order to select the appropriate personnel. With some other tasks, the use of external and foreign expertise was sought. Lastly, commenting on "complexity of the IS project" risk factor, one Director noted that "The higher the complexity, the more time it takes to execute and the lesser the users' interest in its implementation." The remedies used by the NUMIS project for this risk involves the use of prototyping in which modularization and increment systems development approaches were employed. More importantly, a majority of the risks and uncertainties encountered in the course of developing IS projects within the Nigerian University ambience appear to be under the control of the project manager, though there are risks items that are beyond his/her control. See Table 4 below.

Table 4: The Classification of ISD Risk Factors for the NUMIS Project

Risk outside the control of project manager		Risk inside the control of project manager
No control	Limited control	Total control
- Unstable environment (strike, unrest etc.) - IT illiteracy among users - IT illiteracy among top Administrators - Lack of infrastructure (e.g. telephone etc) - Funding inadequacy - Sabotage - Irregular power supply	- Lack of user's involvement during IS development - Insufficient or inappropriate staffing - Failure to manage end-users' expectations - Inadequate users' training of the IS - Lack of top management commitment to the project - Failure to gain users' commitment - Resistance to change	- Unclear or misunderstood scope of project objectives - Wrong development strategy (e.g. prototyping etc.) - Misunderstanding the requirements - Lack of required skills/knowledge in the development team - Lack of effective project management skills. - Poor/non-existent control of project - Changing requirements and objectives - No planning or inadequate planning - Artificial deadlines (unrealistic deadlines) - Complexity of the IS project - Lack of "people skills" management - Complexity of the project - Corporate politics with negative effect on project - Frequent conflicts among development team - Inadequate hardware and software support from vendors - Lack of control over external consultants and vendors - Trying new technology mid way

The classification of the risk is informed by the work of various researchers in Risk Management theory; therein, risks are classified into "outside" risks (those that the project manager has no control over) and "inside" risks (those that the project manager has control over and could be monitored). In the middle are those that the project has limited control over; in other words, s/he could influence to some degree (March and Shapira, 1987; Schmidt, et al., 2000; Lyytinen, 1988; Powell and Klein, 1996; Keil et al., 1998). In sum, energies were expended in managing both the critical and less significant risks and uncertainties in the project according the panelists; nevertheless, the NUMIS turned out a "partial success" in the opinion of the participants of this study because all the original objectives of the project were not actualised. Mid way, there was a change of guard in the National Universities Commission (NUC) and attention was shifted away from the project, leaving the participating universities to contemplate going their different ways, thus jeopardizing the total migration of the project to universities that are yet to acquire it.

6. IMPLICATIONS AND CONCLUSION

This paper reports the identification and management of risk factors encountered in developing information systems (IS) project within university environment in Nigeria. The findings of the study, to a large extent, are consistent with and complement similar work in the region. Overall, the paper highlights the risks that IS projects face from the perspective of a developing nation. Also, insight is provided as to how top project managers within the university environment tackle such risks. The NUMIS project was ascribed "partial success" in a fashion almost typical of IS projects on the continent (Heeks, 2000b). To that end, this work has both implication for theory and practice. First, as was noted, the findings of the study lend credence to findings in the IS domain that tends to indicate the import of socio-economic and organisational inadequacies in respect of IS development and implementation in Africa (Mursu et al., 2000, 2003; Ehikhamenor, 2002). Moreover, the research study makes an attempt to further refine IS project risk factors' classification in a manner that is suitable for studies in developing countries. Second, with regard to practice, the uncovered risk items could serve as *checklist* for IS project managers aiming to develop IS projects within university ambience in similar environments. Further, the availability of the *checklist* may help focus the attention of project managers of similar projects on the risk items that may be crucial to the success of there IS projects. Thus, this study underscores the significance of "top management commitment and support" as a vital ingredient needed to guarantee the success of ISD project within any organisation including university environments. The NUMIS project is fortunate to have skilled and experienced project managers; nonetheless, the project itself was consumed by sustainability and commitment related factors, which the lack thereof resulted in partial success of the project. Essentially, top university functionaries had little or no knowledge of the import of IT and ICT in improving the lot of all stakeholders within the university environment. Efforts aimed at redressing this shortcoming initiated by the project managers seemed to have had no effect in securing the commitment of the administrators. Consequently, the momentum required in sustaining the NUMIS project was lost as resources and commitment got shifted. To that end, the NUMIS project succeeded partially (not too far from outright failure) mainly because of the risk factors under the socio-economic and organisational classifications in this paper, which incidentally are not within the purview of the NUMIS project managers. Risks associated with external dependencies on software/hardware vendors rank relative lowly amongst the participants in the study.

Relatedly, implications for the human resource development through ICT, for Nigerians could be drawn. The study has highlighted the significance of socio-economic, project management and organisational risks factors for the NUMIS project. Broadly speaking, if the United Nation's Millennium Development Goals (MDG, 2000) for a DC such as Nigeria are to be realised with the building of the human resource capacity (skilled and adaptable workforce) that is needed to integrate into the information age (see, WSIS, 2004), then this study suggests that higher educational systems in Nigeria and in similar countries must pay more attention to and/or find ways to provide the sorts of skills or knowledge for their students regarding the "soft" side of information technology. Project management and organisational management skills must not be treated lightly. Ultimately, such skills will go along way in helping to reduce incidents of failed IT/IS projects and the sustainability problems associated with such projects in Africa (Heeks, 200b).

Finally, there are limitations to this study. One of such relates to the small sample size used; though, its impact is lessened considering the fact that the study's participants are influential "key informants" (see, Bradford and Florin, 2003) in the project – at Directorial levels. Another limiting factor is lack of viewpoints from users of the systems as well as other entities in the project. Differing views to those presented herein may be held by such entities excluded in this work due to cost and time constraints. Thus, the generalisability of this study may be impacted by such limitations. Furthermore, the extent to which comparable risk factors as uncovered in this particular endeavour being reproduced in similar settings in Nigeria or elsewhere, may be dependent upon the

nature of project being executed and whose viewpoints being sought. Regardless, the findings in this study concur with similar work in the IS literature. Future study could investigate the perceptions of the users and other entities of this particular IS systems within the Nigerian university; at the same time, focusing the discourse on the problems encountered as the developed software - NUMIS - is being adopted by other universities in the country.

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Training and Capacity Building to Sustain Health Care Information Systems at a Local Level in India

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ABSTRACT

This paper reviews the challenges and opportunities observed during an action research project to develop a primary health care information system in rural India and argues for the appropriateness of local level capacity building both for enhancing sustainability of information technology based health care information systems in resource poor environments and for empowerment of the local level health workers in the information age. The paper draws upon a case study at a sub district level in rural South India extending close to a year. Primary health care information systems using information technology are a new area of information systems development in India and the body of knowledge about them is meager. The paper attempts to draw some implications for practice for developing IT based primary health care information systems in India.

1. INTRODUCTION

This paper addresses the development of a primary health care information system (PHCIS) in India. India, the second most populous country in the world with 1028 million people, has 74.2% of her people living in rural areas, 26% population below poverty line, a literacy rate of 64.8 (census India 2001) and a GNI per capita of 530 US dollars (World Bank 2003). The 2002 Indian national health policy statement states that the available financial resources and public health administrative capacity did not allow the goal set in 1983 of achieving 'health for all by 2000' through primary health care and that goals now have to be reset more realistically (GOI 2002). The need for an effective PHCIS in India has to be seen against this background.

Primary health care information, for example, maternal and child health, immunization against vaccine preventable diseases and prevention of locally endemic diseases, (WHO 1978) is a vital resource for health policy, planning and resource allocation, more so in a resource poor environment. To be useful, this information has to be captured from every individual and family in the community. In India, with a population of one billion plus, this is an enormous challenge.

Paradoxically, while India is increasingly making her mark in the global IT (information technology) scenario by software exports and by the merit of her pool of knowledge workers in this area, she has a weak domestic software market (Heeks and Nicholson 2002). Taking Norway as a reference, country statistics show that for every 1000 people, there are 528 computers and 1578 telephones in Norway (World Bank, 2003a) as against 7.2 computers and 51 telephones in India (World Bank 2003b). Access and use of information communication technology for domestic needs continues to be meager in India thus posing a real threat of marginalizing a large part of the rural population in the country. E-governance initiatives are currently being adapted by some of the Indian states (provinces) in order to take ' IT to the common man' (GOK 2000). A review of 'mission mode projects' of the (Indian) National e-governance action plans 2003-07 reveals that e-governance in health is still a low priority area (GOI 2003).

This background illustrates the 'pioneering' nature of the IT based health information systems project (HIS project) that forms the basis of the case study used in this paper. The HIS project based on the Health information systems programme (HISP)[xxxv] involved introducing IT to promote the use of health information at a local level of the health department of the state of Karnataka in a rural area close to a 'megacity', Bangalore. The motivation was in congruence with an argument put forward by Walsham that 'the development of local people's skills and knowledge of IT, including those of the disadvantaged in society, is the only long term sustainable way to ensure the inclusion of the excluded' to bring them into the global network society (Walsham2001). The purpose of the paper is to argue for the appropriateness of capacity building at *local levels* for sustainability of primary health care information systems (PHCIS) and for empowering the marginalized in an increasingly polarizing environment between urban and rural areas in India in order to indigenize the information systems.

The paper is presented as follows. In section 2.1 and 2.2, we review literature on the relationship between a developing country context and sustainability of information systems and on the link between IT and society in developing countries in the information age. The conceptual framework is based on the notion that in context of a resource poor and increasingly polarizing environment between rural and urban India in the information age, capacity building at local levels contributes to sustainability of a primary health care information system both in itself and by empowerment of the marginalized health workers. The relationship between the various constructs in the conceptual framework is depicted in figure 1. The discussion will explore the relevance of the social and organizational context and human resource development on the process of developing a sustainable PHCIS in rural India in the information age. We conclude by arriving at some prescriptions for developing a sustainable PHCIS at a marginalized site in India.

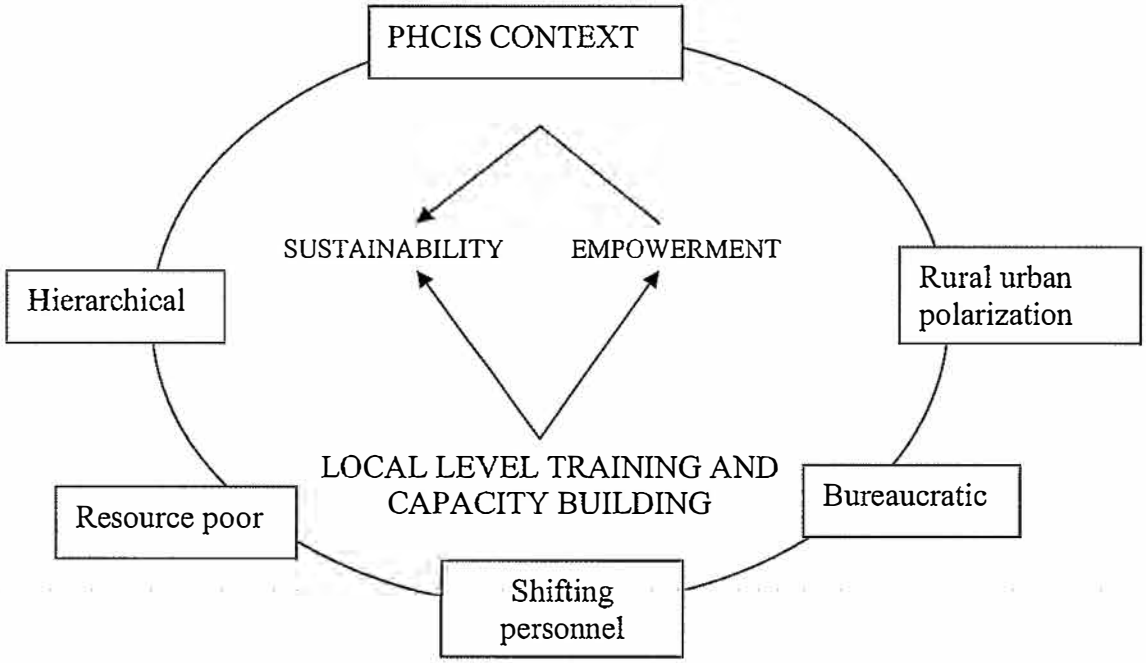


Figure 1: Conceptual framework showing the relationship between context of PHCIS development and the key constructs of sustainability, empowerment and local level training and capacity building.

2. REVIEW OF LITERATURE

2.1. Context and Sustainability

Sustainability is defined by Webster's dictionary as 'using a resource so that the resource is not depleted or permanently damaged' and resource as 'available means'. These definitions are particularly meaningful in the context of a developing country. This section explores reported literature on the relationship between the context of information systems development and sustainability.

Information systems development and use in developing countries is constrained by the lack of infrastructure, financial resources, technically competent personnel, and the constraints of social and political contexts (Walsham 1988). Adapting health information systems to a context, cultivating local learning processes and setting up routines of use all contribute to its sustainability. But health care information systems in particular are also faced with the problem of 'scaling' or spreading these routines all over a health care area. Cultivation and reproduction of local learning processes are seen to be a key challenge in developing a sustainable and scalable health information system (Braa et al 2004). A health information system becomes sustainable only when enough

resources are allocated for the needs of the organization and the users over a period of time. Many donors driven HIS projects are seen as being unable to sustain themselves once donor funding ceases (Kimaro and Nhampossa 2004). Technology requires infrastructure, managerial and technical skills to be operable. The sustainability and institutionalization of such activities is affected by the way institutions react to political and financial pressure resulting in no replacement routines for equipment (Baark and Heeks 1998).

Mursu et al (2000) while advocating a 'Made in Nigeria' methodology for information system development point out the need to be sensitive to cultural, social, political and moral aspects of the design. They summarize three main constraints of IT projects in developing countries as inadequate infrastructure like power supply and telecommunications, shortage of skilled personnel because of poor planning and inability to manage change and a public sector culture which is 'colonially inherited' and unsupportive all of which affect sustainability (of IT systems) which is defined by them as 'ability to identify and manage the risks threatening the long term viability of the information system or of the information system development activity' while agreeing that education and other empowering strategies are important to overcome this. They conclude that the requirements of sustainability, affordability, socio economic justification, user/community participation and practicality should be kept in mind while designing for Nigeria and Africa.

Heeks et al (1999) refer to 'sustainability failure' of health care information systems (HCIS) and argue that factors determining success and failure are contingent, that is, specific to the situation and needs to adapt to change. To be successful, a HCIS must conform to technical, social and organizational elements including the perspectives of the participants. Health care professionals need to 'hybridize' combining IS and IT skills with knowledge of the health context and to become 'change agents' who help to implement change and build the capacity of others to change.

Oyomno (1996) while building an argument for the relevance of sustainable technology for development in the developing world points out that technology might be inappropriate in terms of the financial requirements, human resource requirements and the organizational changes needed to make it sustainable.

2.2. Information Age and Developing Countries

Electronic communication in the new world allows 'simultaneous and reciprocal' communication across many natural and man made frontiers such as continents and countries and help to build new communities of shared interests. But it cannot build 'classlessness' as it is available to 'barely 1% of the world's population' (Beck 2000).

In the 'rise of the fourth world', Castells (2000) writes that informationalism, as in the present times, is linked to inequality, polarization where social differences between the top and bottom segments of the population is sharpened, poverty and misery. While describing the exclusion of Africa from the information technology revolution, he argues that presently, the use of IT is the key to wealth, power and knowledge. Walsham (2001) summarizes his views by saying 'Globalization proceeds selectively, including and excluding segments of economies and societies in and out of the networks of information, wealth and power that characterize the new dominant system'.

Megacities, in low income countries have been quoted as 'they connect the affluent minority in developing countries to global networks and to growth centers within their own countries, while at the same time they disconnect the vast majority of inhabitants who are becoming increasingly peripheral from the major processes that fuel economic growth' (Madon and Sahay 2000).

3. METHODOLOGY

The case study site is a taluk, that is, an administrative sub district in Karnataka state (province) in India. The empirical work is based on an action research project adapting and implementing a health management information system for primary health care. The study covers a period of approximately one year during the year 2003 when one of the authors was the facilitator for the project. This author belongs to the state of Karnataka and was well conversant with the local language Kannada. She was deeply immersed in the implementation process assuming multiple roles, from liaising with the government, participating in the implementation including customization of the software, designing and delivering 'hands on' training programmes,

communicating with the HISP network and documenting events and processes. She thus had complete access to both the process and the context of implementation with complete participation and a high level of involvement (Spradley 1980). The data was gathered by participation, observation and conversations at all levels of the health system during the implementation; having access to many officials of the government; observing meetings of the health department at taluk and district levels where health information was discussed; conducting workshops at senior levels; conducting training programmes at junior levels and inspecting documents such as routine health reports, training manuals, publications by the various divisions of the national and state health departments. An interpretive method was used to analyze the case study with the aim of understanding issues of sustainable information systems development, capacity building and empowerment at local levels (Walsham 1994).

4. CASE DESCRIPTION

4.1. Primary Health Care Information System In Karnataka

Karnataka state is seen as one of the leaders of e-governance initiatives in India. The state is divided into 27 districts which are further sub divided into administrative sub units known as taluks. The primary healthcare system in Karnataka is district based and the taluks are gradually being vested with more powers by the state and district health administrations in order to improve decentralized health administration. They are headed by the district health officer (DHO) and taluk health officer (THO) respectively. Our case study taluk had 9 primary health centers (PHCs) delivering health care to the community and handling health information. The lowest unit of the primary health care delivery system is the sub center reporting to the PHCs.

The sub centers serve the health needs of approximately 5000 population and are staffed by local level health workers known as junior female health assistant (JHAF) and junior male health assistant (JHAM)) respectively. The health workers, though hierarchically placed at the lowest level, play a vital role in the primary health care system as they form the first and most common interface between the community and the primary health care system. The sub centers are the point where most health data enters the system. The JHAM and JHAF at the sub centers along with their supervisors at the PHC level are the primary data handlers in the system, being responsible for collection and collation of primary health data. The PHCs in turn report both to the taluk and to the district.

Presently, the HIS is paper based and 'data led', that is, the large volume of health data consisting of about 900 and odd data elements collected at the local levels are seen as an 'end in itself' and most of it is not used for making informed decisions (Sandiford 1992). Our observations showed that earlier attempts to reform the system has resulted in a number of new forms being introduced resulting in multiplicity of forms and redundant data collection. A large part of the local level health workers' time is spent in collecting and collating data with scant attention paid to the quality of data. The major output of the health information system is over twenty routinised data collection forms every month for upward transmission. No written feedback of analyzed data is delivered to the health workers and most of the data is not used for local decision making and action.

4.2. Implementation

About 8 months before the HISP project started, an IT based donor project with the broad aim of bridging the digital divide by providing access to health information had placed three computers in the case study taluk. The project had multiple objectives such as providing health information to health workers and to the community, providing tele consultations, etc. Involvement of multiple actors in the execution of these projects, made it appear that there was no clear ownership of the system either by the donor agency or by the users. Permission was given by the commissioner of health for the state to install the District Health Information Systems (DHIS), an open source, freeware for primary health care developed by HISP South Africa, for implementing an IT based health management information system in this taluk. An attempt to develop a PHCIS at state level the previous year had failed as the software vendors and the government could not come to an agreement about the terms of implementation. The HIS project team entered the taluk in early 2003. The DHO acquiesced as he saw it as being supported from above but did not appear to show any particular interest in taking it forward. The software was adapted for local use and a report generating software module replicating the existing reports was added. The replication of existing reports was seen to be enrolling in the use of the software. In order to minimize the demand on resources, a plan was made to locate the IT equipment for the use of the 9 reporting PHCs at 3 geographically accessible locations in the taluk. These three locations were designated as 'IT hubs'. It was

planned that the health data from the 9 PHCs would be entered by the health workers at these hubs and exported to the taluk and district levels through e mail or CDs. The health workers could also analyze health data for local use at these IT hubs. Figure 2 depicts the 3 IT hubs and data flows for the 9 reporting PHCs in the taluk.

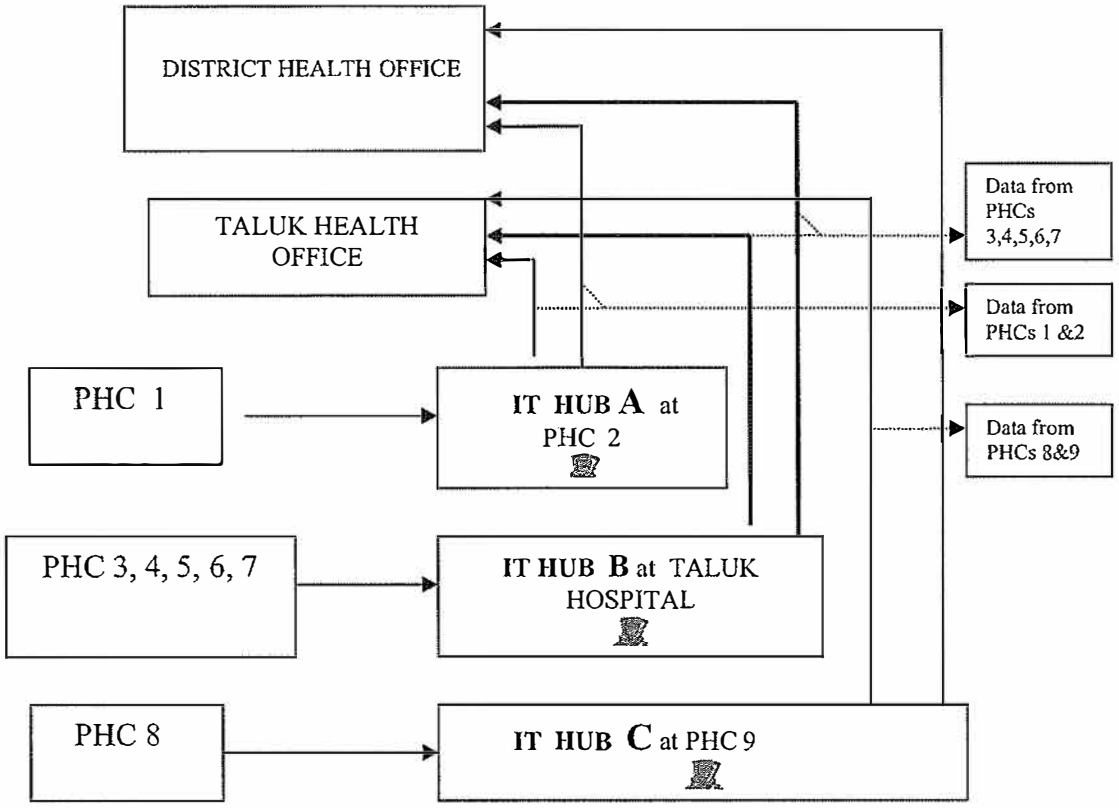


Figure 2: Plan of IT hubs where IT equipment was placed for data entry, transmission and analysis in the case study taluk. PHC 1 and 2 to use a computer placed at IT hub A, PHCs 3,4,5,6 and 7 to use a computer at IT hub B, and PHCs 8 and 9 to use a computer at IT Hub C. Arrows show data transmission upwards from these three IT hubs to the taluk and district health offices.

4.3. Health Managers in Transit

In the one year the HIS project was in action, the managerial levels at the health department changed hands several times. The commissioner for health was transferred the week after he gave the permission for the project to start. The project was then introduced to the next commissioner for health who was interested in seeing it piloted. The DHO was transferred midway during the project and his place was temporarily held by another officer for about one month. By the end of the year, a third DHO was in place. During the year, the post of THO was transferred between four medical officers, three of whom had been holding additional charge along with their duties as clinicians in the taluk hospital. While both commissioners were aligned with the aims of the project, the other officers had varying levels of understanding and interest and had to be re enrolled into the objectives of the project each time with varying levels of success.

4.4. Training infrastructure

The total IT infrastructure of the taluk health department consisted of three desktop computers with CD writers, a ink jet printer and scanner placed at two peripheral PHCs and at the taluk hospital (Pop:350,000) all given by the donor project. As internet connectivity was considered an important component of this initiative, connectivity by providing telephones was also facilitated at the two peripheral PHCs by the donor agency. While the computer and telephone had been placed in one building at the taluk hospital (IT hub B), the personnel concerned with

information handling were based at a building 3 kms away. The two other computers were placed at PHCs which were approximately 40 kms away from the taluk headquarters, one to the south (IT hub B) and the other to the west (IT hub C). The district health office had 2 working computers in about 40 square feet area. Though the taluk as well as the peripheral hub PHCs had electricity supply, it was rationed and was cut off for several hours every day either in the morning or in the afternoon.

4.5. Maintaining Technological Infrastructure

The donor agency had provided a budget of around 100 USD per month for approximately twelve months for consumables. No other budget was available from the district or state health department for the maintenance of these computers and consumables. Information about maintenance contracts was not available with the taluk or district health office. Due to frequent change of officers at the taluk and district levels, this information had not filtered down to current incumbents. Towards the end of the year, cartridges and paper for the printer and payment of telephone could not be financed and both the printer and the internet connection could not be used.

4.6. Training Process

A training programme for computer skills had been put in place by the earlier donor project team in association with the taluk health administration and this began just around the time the HIS project team entered the picture. A local franchisee of one of the largest IT training companies in India had been given the contract to train the personnel of the PHCs in the use of computers for two weeks. It was a small place of about 200 square feet with six computers and two instructors. The trainees were a mix of clerical and health staff and many had to travel about 40 kms at their own expense and be trained for two hours beyond their working hours. There was a high degree of absenteeism.

Early on in the project, it was decided to train the health workers locally at PHCs incrementally in computer skills, data entry and the use of health information for local action. The mid and top managerial levels frequently expressed skepticism about the ability of the health workers to handle computers.('*They (the health workers) will not be able to learn to use computers*'). As most personnel trained earlier were not data handlers, a different group of trainees including JHAMs and JHAFs and their supervisors who handled routine health data collection and aggregation were selected.

In spite of a written direction from the THO, attendance at the onsite training sessions was poor. The health worker said they were busy with their field work such as tubectomy camps and that that they could not spare time to be in the PHC for the training. Quite often, there were complaints from both the trainers and the trainees that when they met on site there was no electricity or that the room with the computer and telephone was locked up. Though back up power for 2 to 4 hours was available at some PHCs, there was resistance from the medical officer to use this saying it was needed for maintaining the ice box. The trainees from centers where there were no computers had to pay their own bus fare to attend training sessions and did not show up in desired numbers even after organizing dates for them.

It was then decided to organize a centralized training programme at the taluk town hospital where all the data handlers, most of them junior level health workers, from all the reporting PHCs were asked to attend. Obtaining necessary (written) permissions from the health authorities at the state and district levels took about 2 months. The training dates had to be coordinated with a time when the health workers were perceived to be relatively free of other pre scheduled in house training programmes, tubectomy camps, family health awareness camps, etc, and written permissions obtained. A centralized place large enough for training was not available as the local franchisee IT training institutes were too small. It was then planned to hire computers from one of the local IT training institutes and locate the training at the operation theatre which had not yet been commissioned. A week before the training was scheduled, both the local IT training institutes were closed down by their financing institutions as they had not repaid their loans. Computers had to be hurriedly hired at Bangalore and transported to the training location as there was no other capacity available locally. At the end of two days, all participants irrespective of their previous exposure to computers were able to learn data entry skills. During the training it was observed that three of the trainees who had earlier learned to work with DHIS voluntarily took on the role of trainers assisting their colleagues with computer skills. The participation was enthusiastic and the health workers

added a finale by writing and singing songs about the use of computers. All of them expressed the wish to learn more, but attendance of the trainees continued to be poor over the subsequent months.

During the training, 57 year old 'Shanti', (close to retiring age), a JHAF in charge of one of the sub centers, showed active interest in learning basic computer skills and working with DHIS as she expressed, '*my daughter and son in law both work with computers*'. She was a first time computer user. Over the course of 1½ days of training, she produced a report after entering data from her sub center for the current month. She was disappointed as the printer ran out of ink and she was not able to generate a complete set of reports.

While the HIS project was in progress, several other IT initiatives for health systems management were being put in place by the state government through different donor funded projects and trainees were picked randomly from the taluks for these programmes.

4.7. Emerging Local Champions

It was planned to develop the three JHAMs who showed aptitude as in house trainers by inviting them to Bangalore city for specialized training. Of these three, one JHAM, 'Prasad', came from a PHC where no computer had been placed. On his own initiative, he had gone to the neighboring PHC every evening and trained himself well with the use of the software and could enter the data for one reporting month in about 20 minutes. He came to the taluk level meeting with a sheaf of printed reports announcing that he was the first person in the taluk health system to start using a computer. It was then suggested to the THO that since 'Prasad' showed the correct aptitude, attitude and skills to sustain a computerized health information system for this work, he could be posted to the taluk headquarters to manage the database for the whole taluk. This required written orders from the DHO. The DHO suggested that the request should be made to the CEO of the district. The CEO was enrolled into giving a written order to the DHO to transfer 'Prasad' to the taluk. The DHO in turn passed an order directing the THO to transfer him. The whole process took close to three months. Once 'Prasad' was posted to the taluk headquarters, he took charge of the taluk database, getting hard copies of the reports from all the PHCs for data entry and generating reports. 'Prasad' was also trained further in issues of data accuracy and validation. He was also given the brief of training any of the health workers who showed interest in being trained. 'Prasad' established himself as the 'computer man' at the taluk and gradually many matters regarding computers started being referred to him. When the state health secretary visited the taluk, 'Prasad' was asked to introduce the system to him. 'Prasad' also acquired enough competence to train his colleagues in the health department in the basic use of the application software. After 'Prasad's position was established in the taluk, when a new training programme was initiated, he was selected for the training programme at Bangalore even though all other taluks were represented by clerical workers. With this, a new workable architecture for the PHCIS began emerging at the local level (taluk) as depicted in figure 3.

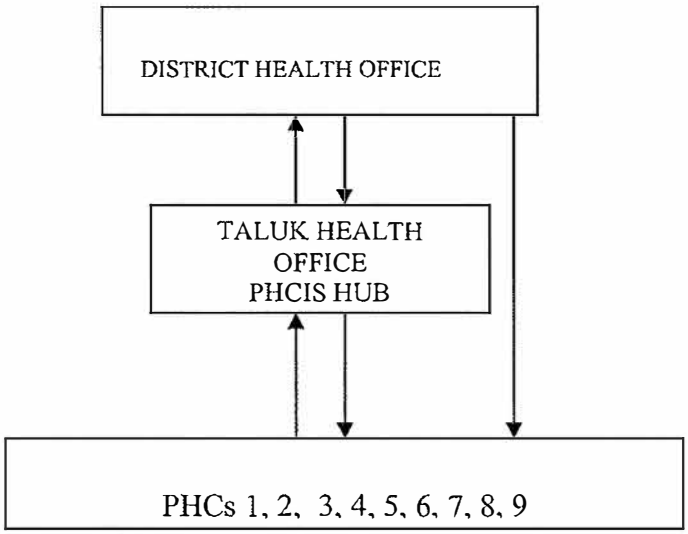
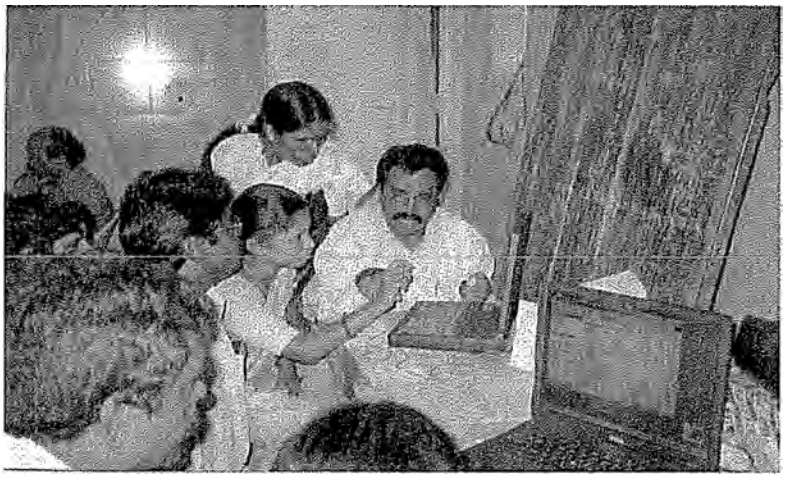


Figure3: Local level (taluk) emerges as the PHCIS hub for health information management by trained local level health workers and for placing IT equipment. Upward arrows depict data flow from PHCs 1 to 9 to the PHCIS hub at the taluk level for data entry and analysis and further from taluk to district via CDs/hard copies. Downward arrows indicate feedback.

Picture 1 shows a JHAM training a JHAF



Picture 2 shows JHAM training his colleagues. The trainer's personal laptop is being used to supplement training infrastructure.

5. ANALYSIS

5.1. Organizational Environment In The Health Department

The bureaucracy in India is marked by lack of flexibility, strict adherence to regulations and hierarchy. This is often described by the popular media as a legacy from the time of British colonization. Most officers in the chain were rigid in adhering to the rules and saw themselves as 'taking orders' from above when a new routine had to be set up without going into the level of ease with which it could be organized at their level. All instructions from each higher to each lower level had to be delivered on paper and several months passed before a plan became operational as in the case of arranging the group training session and 'Prasad's transfer.[xxxvi] In the Indian

hierarchical context, new systems have to be legitimized at top levels in order to become routine. Frequent shifts at the top and mid level emphasize the need for institutionalization of these new routines as high level support is a pre requisite for sustainability.

During the course of the project, the health department of the taluk was exposed to three different projects and training on computers with different people being trained each time and same or different skills being offered. At times, training programmes were organized in a hurried manner to beat deadlines. Given the resource scarce environment, training processes need to be brought into alignment to build a stable group of IT users at local level.

Though the officers at the top level of government were interested in driving the whole process of capacity building, frequent transfers did not support it. The pro IT stance of the state government had not trickled down to the mid levels. The mid levels did not perceive much value in the use of IT for HIS, as the existing HIS being mostly 'data led' did not have a well established culture of information use. In contrast, none of the local level health workers were transferred out of the area during the case study year and this enabled participatory approaches and training of a stable group at the local level. Due to frequent shifts at top and mid levels, the practical working of the IS needs to be grounded in the more stable local level by training health workers at this level. This also aligns well with the concept of 'empowering' local levels which in turn leads to more sustained use of the PHCIS.

Technological and physical resources were meager at the local level, with 3 computers available for 9 PHCs both for processing health information and for training close to 70 health workers. Lack of training infrastructure became a major actor in the process of sustaining health information systems. At the mid and top levels, rigid organizational routines which required extensive paper work and time were perceived to be necessary before any innovations were put in place. The local levels were less rigid and more resourceful in setting up new routines. Maintenance procedures such as replacement of cartridges, or payment of telephone bills were not routinized as it was a donor funded project. Use of open source software reduced dependency on commercial software vendors and could be adapted in a cost effective way by the two software people in the team.

5.2. Empowered Local Levels

In the health system, the social level of the employees is determined by their designation. It is common practice for health workers to stand up and remain standing while a senior is in the room. Computers were seen as a symbol of power and at times access was denied to local level health workers by locking up computers and telephones and denying the use of back up power for apparently 'rational' reasons. The health workers in turn maneuvered power relations by not attending training sessions in spite of written orders by using 'rational' reasons such as tubectomy camps.

The health workers showed enthusiasm for the acquisition of IT skills. The case of 'Shanti', who in spite of the 'disadvantage' of being female, junior and older in a hierarchical system, the enthusiastic participation by the health workers at the group training and the generation of local champions during the training sessions emphasized the empowering nature of IT. In the absence of formalization of ongoing routines of IT training from the top levels, the health workers did not participate in the training processes continuously.

The unexpected emergence of 'low level local champions' such as the three health workers who became trainers was an important dimension in aligning the process of capacity building. 'Prasad' achieved the position of 'computer man' of the taluk by his increasing mastery over computers. With his transfer, the taluk became the operational computer hub. He became an important actor in sustaining the information system as he acquired enough competence to handle monthly data from all the PHCs and to train his colleagues. His position in the hierarchy became more powerful as seen by the THO inviting him to be present when the state health secretary came visiting. 'Prasad' assumed multiple roles such as computer manager and trainer by the end of the year illustrating the roles of 'change agent' and 'hybridization' (Heeks et al 1999). This suggests that even in resource poor and hierarchical environments the formative context itself can be 'tweaked' to support sustainability and scaling. The health workers who acquired competence in IT skills became key components for sustaining the system. While the health workers acquired computer skills quickly, there was no sense of urgency about becoming more proficient and sustaining use as it had nothing immediate to offer them. 'Out of pocket' spending on travel to another PHC, political support[xxxvii] were other deterrents. Developing champions at the

local level can be a key issue for sustainability. Local champions can become enablers of the system provided there is a 'buy in' by the top management which provides them an enabling environment.

6. DISCUSSION

Our experience shows that the key needs of providing technological infrastructure and training for sustainable capacity building in a health information system have to be addressed within the framework of a resource poor, bureaucratic and hierarchical context in India (Walsham 1998; Mursu et al 2000; Oyomno 1996). The local levels provide an environment where health information systems can become sustainable and empowering.

Emphasizing local levels empowered the health workers and reduced the risk of their being marginalized in an increasingly inequal and rural urban polarizing society in India (Castells 2000). Learning IT skills and continuous access to IT at local levels empowered the health worker, raised his level in the hierarchy and motivated more sustained use of the system, thus making the health information system also more powerful and sustainable. In order to enhance sustainability the users have to develop a sense of ownership and commitment, which need to be developed through an enduring focus on local usefulness and local use of health information for immediate feedback and use. This in turn motivates capacity development and understanding. The key to sustainability is to create a 'learning environment' building on the dynamic interlink between local ownership fostered through participation and addressing of local needs, and the drive towards developing their own capacity to run and understand the system and the technology, stemming from this local commitment and self interest.

Walsham (2001) quotes from a study where new information systems 'empowered' mental health workers by shifting their professional identity from direct health care to health care management. This is also corroborative of Braa's (1997) argument that that 'deprived communities are not threatened by technology; they are threatened by being ignored and sidelined by the technology' (Braa 1997).

Generating 'low level local champions' from within the system; the stability of the local level organizational structure when compared to middle and higher levels; the competence of the health workers in learning IT skills; the emergence of a workable 'computer hub' at a sub district level; lessening the need for following rigid and time consuming bureaucratic routines as when innovations are ordered top down, emphasize local level capacity building for sustaining health information systems. Financial resources have been mentioned as a major constraint in information systems development (Walsham 1988; Baark and Heeks 1998; Mursu et al 2000; Oyomno 1996). The meager IT infrastructure and lack of funds for its maintenance emphasize the scarcity of resources in the health system. Situating the IT based health information system at a single hub at the sub district level (taluk) can decrease the demand on financial resources by decreasing trained manpower and technological infrastructure needs thus facilitating more continuous operationalization of the system. It can provide a stable local base for training thus facilitating cultivation and reproduction of local learning processes for sustainability and scaling (Braa et al 2004). To be workable, as in the case of 'Prasad', this organizational restructuring can involve change agents, health workers with a 'good fit' for IT (Heeks et al 1999). The taluk (local) level was close enough to allow the health workers to have access to their own data and information continuously and overcome the cumbersome bureaucratic processes which would otherwise have been necessary for establishing 'feedback' routines. By appropriating the principle of 'hierarchy of standards' which allows local units to make local translations but only as an extension of a standard data set, the local level can continue to be aligned with other vertical and horizontal levels (Braa et al 2004). It can be theorized that a fall out of improved access to information is to sensitize the health workers, as primary gatherers of data, to the need for good quality data, though we are still too early in the implementation to comment on this.

Being a pilot project, changes in organizational routines were not prioritized and the rigid and hierarchical structures and routines resulted in long delays at every step. Changes in organizational structure and organizational routines, for example, appointing local level health information managers, routines such as training programmes and technological infrastructure maintenance need to be institutionalized when HIS initiatives are scaled up to make them sustainable. Kimaro and Nhampossa (2004) refer to the need to integrate routine work practices through institutionalization in order to make an IT system sustainable. Coordinating Pilot projects such as these in a 'green field' setting, are valuable for learning 'what works' *at a micro level* prior to large investments in IT driven projects in the health care sector in developing countries.

The problems of maintaining and using the technological infrastructure reiterate the failure in sustainability of donor driven projects in developing countries (Kimaro and Nhampossa 2004; Oyomno 1996). The organizational structure, routines and finances cannot support sustainable maintenance of technological and human resources once the donor agency withdraws. Coordinating different donor driven IT projects to bring about a common platform of training and capacity building at local levels is another challenge. Using open source software can reduce costs and increase flexibility if competent 'in house' maintenance support is given.

7. CONCLUSION

The experience of developing a HIS at a local level in India brings out both the opportunities and challenges in the process. In this paper, we have drawn on our experience to bring out the importance of the local level in both sustaining a health information system and in 'including the excluded'. The marginalized health workers at local levels are empowered by training them in IT skills and providing access to IT by locating IT infrastructure at local levels such as the taluk. With continuous access, health workers are able to train themselves and support each other in use of IT and health information. Acquisition of IT skills and knowledge of health information raises their status in the hierarchy by providing them skills that are not available at higher levels of the hierarchy. The sustainability of the PHCIS is enhanced by developing a team of skilled, empowered health workers at the stable local levels who sustain the use of the system. Grounding the PHCIS at the stable and active local levels, together with an enabling environment from the top and institutionalized routines of use, can sustain a PHCIS, reduce the demand on scarce resources by limiting the number of locations where IT infrastructure is provided and align well with the empowerment of local levels.

Developing countries can learn about how best IT can be applied for development only through the exploration of application and use of IT in local contexts and, as we have illustrated in this article, of how human capacity can be developed to run such systems. Human resource development needs to address the whole range from end-users and their organizations to IT professionals and universities. By engaging in developing locally useful systems, users and organizations will learn about how best to apply IT and they will, if they see it as useful, develop the necessary capacity to run and sustain the systems. At the same time, by engaging in such local development, IT professionals and universities will learn about how locally appropriate systems may be developed. By engaging in developing locally useful IT applications, a wide range of processes of learning and human resource development may be initiated. Local participation and involvement are important factors in initiating such processes of institutional learning.

Finally, the non sustainable nature of donor driven projects at local levels and the value of pilot projects for scaling up health information systems in a sustainable way in a developing country context are also brought out.

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SESSION C1: RESEARCH PAPERS: IT & HR DEVELOPMENT IN THE PUBLIC SECTOR

Importance of Human Resource Capacity in the Context of Low Income Countries

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ABSTRACT.
Information and Communication Technologies (ICTs) are typically introduced in organizations with the promise to help to manage resources, increase efficiencies, reduce workload, and increase work productivity. However, in the context of Low Income Countries (LICs), the lure of these promises is magnified given the existing conditions and inefficiencies. International aid agencies play an important role in shaping this promise. However, introduction and use of ICTs in LICs has proven problematic due to failures or unsustainability resulting from many factors. One important factor is the lack of appropriate human resources both with respect to quantity and quality. This paper emphasizes that human resource capacity building in LICs is an urgent issue of concern for the sustainability of ICTs. It draws on concepts of sustainability, ICT literacy and human capacity building to analyze challenges related to human resources in the Health Information System (HIS) and ICTs in the health sector of Tanzania and suggests some strategies to address the problem. Specifically the paper focuses on ICTs initiation in the context of the health sector and argues for human resources with a mix of skills to understand the meaning of data, information and the use of computers. However, the degree of skills and knowledge of human resources is highly dependent on the needs, work processes and attached responsibilities of the specific levels of the health sector.

Keywords: ICT literacy, human resource capacity, sustainability, HIS, health sector, LICs, Tanzania.

1. INTRODUCTION

The use of Information and Communication Technologies (ICTs) can help healthcare sectors in LICs to potentially plan, monitor and evaluate health services and communicate more effectively within and across organizational hierarchies (Bhatnagar, 1992; Braa and Blobel, 2003; Chandrasekhar and Ghosh, 2001). However, the literature provides a number of examples where assumptions about ICTs being critical for bringing about change in LICs, have been problematic (Avgerou and Walsham, 2001; Madon, 1993; Chandrasekhar and Ghosh, 2001; Silva and Figueroa, 2002). One of the key challenges is linked to the lack of awareness of ICTs and the lack of well trained ICT professionals (Bhatnagar, 1992; Walsham *et al.*, 1988; Sahay, 2001; Waema, 2002).

Historically, after the end of colonial regime between 1950s and 1970s many African LICs were left without appropriate human resources and infrastructure. The post colonial phase started with eradication of traditional illiteracy and the development of social services for the majority. However, higher level literacy remained problematic as a result of the poor economy, the low quality of education, and the unconducive environment (Wangwe and Rweyemamu, 2001; Sahay, 2001; World Bank, 1999a). For example, in 1991, Tanzania had a work force estimated to be slightly less than half of its 34.5 million people with only 8.5 percent people who had post primary education (Tanzania country web site). Moreover, the internal/regional conflicts in some of these countries affected the existing post colonial infrastructure and weakened national capacity building efforts (e.g. Mozambique in Mosse and Sahay, 2001). In addition, educated elites migrated to developed countries in Europe and USA (Wangwe and Rweyemamu, 2001).

The use of ICTs in LICs is very low, estimated to be only 2.5 % of people living in LICs one of the many problems attributing to this is ICT illiteracy (HRDR, 2003). A study by Braa *et al.* (2001) in the health sector of Mozambique indicated that only very few people had basic skills in ICTs and only few health workers at health facilities understood how to interpret health data. Moreover, Ndumbaro's (2003) Tanzanian health sector survey of ICT applications in 5 out of 26 regions in Tanzania indicated that only few health professionals had received formal training in ICTs with the actual usage of ICTs being very low. The problems cited by Ndumbaro (2003) were scarcity of expertise and skills in ICTs.

The World Bank's Knowledge for Development report (1999b) attests to the importance of knowledge capital for ICTs. Typically, ICTs cannot deliver any benefits on their own unless they are supported and enhanced by skilled human resources and appropriate institutional capacity. The international aid agencies have often included

initiatives for the development of literacy with their own projects in LICs providing only some basic training that does not lead to appropriate human resources to sustain the projects after foreign experts have left (Korpela *et al.* 2000, Heeks 2002) .This consequently leading to a situation of unsustainability (Heeks *et al.* 1999; Heeks and Baark, 1998; Braa *et al.,* 2004; Paul, 1995) as locals with little knowledge, find it difficult to act independently to manage the ICTs over time. Similarly, the local government projects initiated without donor support equally lack attention to continuous human and institutional capacity building. The insignificant spending in social services and lack of resources in LICs adversely affects the quality and quantity of training and skills development.

This study is based on the Health Information System Programme (HISP) in Tanzania which is part of the global action research initiative aimed at improving health information systems (HIS) in LICs with the use of ICTs (See, Braa and Hedberg, 2002; Braa *et al.* 2004). Since the inception of the HISP in South Africa in 1994, its associated tools and approaches have undergone several improvements while trying to address the key problem of the lack of appropriate capacity in LICs (Braa et al. 2004; Muquingue *et al.*, 2002). The question addressed in this paper is: What is the nature of human resource capacity requirements to support the initiation of ICTs in the health sector and how it can be developed to contribute to sustainability of the system? The case study presented in the paper, sheds light on the ICTs capabilities and skill gaps that exist in the health sector of Tanzania which clearly well conforms to the theme of the conference.

The paper is organized as follows. The next section describes the issue of human resource capacity and its link to the sustainability of HIS and ICT literacy. Details of the research setting and approach are provided in section 3 whereas in section 4, a case study of HIS from Tanzania is presented. Following this, the analysis and discussion of the human resource problem and some strategies to address it is provided in section 5. And some conclusions are presented in section 6.

2. THEORETICAL PERSPECTIVES: HUMAN RESOURCE CAPACITY, SUSTAINABILITY AND ICT LITERACY

2.1. Human resource capacity

The problem of weak human resource capacity in LICs is reported in a number of publications (see, Walsham *et al.* 1988; Bhatnagar, 1992; Waema, 2002; Sahay, 2001; Sahay and Avgerou, 2002). It is not uncommon to find a health manager with limited computer skills (Waema, 2002) and a lack of time and motivation to learn. This could be a result of unconducive environments and lack of training resources (World Bank, 1999a; Paul, 1995).

Ideally, capacity building is not limited to basic skills only but also to technical, planning, policy analysis and formulation, and management of ICTs. It involves activities related to the development of human resources through training, education and promotion (Targowski and Deshpande, 2001, Ball, 2001). It is also a continuous process whereby people and organizations develop their abilities individually and collectively with aim to perform activities, deal with problems and formulate and achieve objectives (UNDP, 1994; Paul, 1995). Human capacity building depends on the institutional capacity to provide a conducive environment for learning. Institutions with unclear objectives, inadequate structures and resources, lack of incentives or weak practices are unlikely to achieve productive and motivated human resources (Paul, 1995) because these factors do not lead to a conducive environment. Thus, local governments and donors need to create an enabling environment, supportive of capacity building to ensure the development of sustainable ICTs.

2.2. Sustainability

Sustainability of ICTs implies the ability to identify impacts and manage risks threatening the long-term viability of ICTs (Reynolds and Stinson 1993; Korpela *et al.* 1998). The failure rate of ICT projects in LICs is 75 per cent higher than in developed countries (Heeks, 2002) mainly due to the lack of appropriate skills and knowledge to identify and deal with the risks associated with ICTs on a long term basis (Odedra-Straub, 1990; Heeks 2002, Mursu *et al.* 1999, Korpela *et al.* 2000).

The development of knowledge and skills requires learning and training to use and support ICTs which is critical for the sustainability of ICTs (World Bank, 1997; Braa *et al.* 1995; World Bank, 1999a). ICTs can have an impact on organizational work practices when the people have the necessary capacity to use, maintain, develop and sustain it (Braa et al., 1995; Walsham, 2000). Otherwise, ICTs become obsolete and unused, and resources are wasted. The process of learning and training involves adaptation of the ICTs in the new context of use and the establishment of routines for support and maintenance (Kenny, 2000; Braa *et al.* 1995).

Traditionally, donors have used foreign experts to fill in professional gaps and transfer skills to LICs (Kimaro and Nhampossa, 2004; Korpela *et al.* 2000). The process of transferring skills often is not possible due to the nature of the projects which place little emphasis on learning. Donor projects are typically used to mobilize resources (e.g. vehicles, computers), and not developing human resources capacity (Wood-Harper and Bell, 1990; Sahay and Avgerou, 2002; Paul, 1995). Donor projects generally include poorly designed and short term training programmes (Wangwe and Rweyemamu, 2001) which are not culturally compatible with the local situation. The availability of ICTs needs to be complimented by the availability of well designed training and practices to develop human capacity with appropriate skills and knowledge to sustain ICTs over time.

The HIS is a combination of people, tools (e.g. ICTs) and routine procedures to provide and use information (Boerma, 1991). A sustainable HIS can be simply defined as the one that meets the information needs of the healthcare sector over time. However, sustainability of HIS is a complex process as it involves the capability (skills and knowledge) of humans to collect, analyze, use and disseminate information as well as to deal with risks threatening ICTs. Thus, ICTs may be used as a tool and become part of HIS with people remaining as the cornerstone for understanding the significance of the information collected, making sense of the information and using it for action, thus providing for the sustainability of HIS. Lippeveld (2001) emphasizes the training of health staff to obtain knowledge and skills to use and explore the ICTs so as bring effectiveness and efficiency in the HIS.

...introducing computer technology is not necessarily the silver bullet that creates effectiveness and efficiency in health services. On the contrary, lack of appropriately trained staff and hardware and software problems sometimes result in the decay and obsolescence of expensive computer equipment, without any gains in decision making (ibid, p.24).

2.3. ICT literacy

ICT literacy adds new demands to traditional literacy (Harvey, 1983), including the use of hardware, software, and communication networks. ICTs also redefine the manner in which text is traditionally represented e.g. indexing, zooming in and out, etc. (Selfe, 1996; Cesarini, 2004). However, ICT literacy is not static as technology changes over time, thus old skills need to be upgraded (e.g. change from DOS to Windows). ICT literacy involves not only technical skills, but also skills for dealing with information, and understanding the impacts of ICTs on work processes.

ICT literacy is never limited to a single discipline (Volti, 2001). Training in ICT literacy is dependent on the social context of use whereby existing cultures and politico-economic structures influence individual's learning and participation in training (Williams, 2001). Thus, the transfer of literacy involves a cultivation of new cultures of ICTs use including ways of processing, analyzing and using data in HIS (Heeks, 2002; Ingram and Clay, 2000). Cultivation is a gradual yet progressive process involving institutional changes as a result of learning (Clemens and Cook, 1999) through local adaptation, use and the creation of new routines (Braa and Blobel, 2003). Thus, a new setting is developed which in turn demands long term training and learning. This implies examining not only individual literacy but also the socio-cultural, political and economic factors that shape literacy (Gee, 1999), including the institutional context (Kling *et al.* 2000; Braa *et al.* 2004; Hanseth and Monteiro, 1998).

3. RESEARCH SETTING AND APPROACH

The case study is based in Tanzania, a LIC located in Eastern Africa. The country faces serious constraints related to poor physical and communication infrastructure while depending significantly on donor agencies for the provision of funds to rehabilitate the infrastructures, alleviate poverty and support the public health services. The country's quality of provision of education is affected by low morale of teachers, poor conditions of work and lack of educational resources. (Juntunen, 2001).

The case study is part of an action research initiative within the HISP (Braa *et al.,* 2001, Braa *et al.,* 2004). The aim of applying action research is that it provides health workers and researchers with a chance to work together to effectively design and operate ICTs and use information for action, share learning and experiences and to become more aware of the options and possibilities for changing in their context (Braa *et al.* 2004). HISP uses the District Health Information Software (DHIS) (Braa and Hedberg, 2002) to assist in the process of storing, analyzing and presenting routine health data for making informed decisions. The key intervention strategies are training and participatory design (Grudin, 1991; Walsham 2002; Greenbaum and Kying, 1991) of the DHIS to

facilitate leaning. The case is based on the author's experiences as an action researcher as a part of the HISP team in Tanzania since its inception in 2002, involved in the implementation, adaptation, and training of the DHIS in two coastal districts (Bagamoyo and Kibaha). This has involved studying data flows and use at various levels in the Ministry of Health (MoH) while participating in key discussions and events with health staff and officers on issues related to the existing HIS and ICTs. Thus, the case study was based on a number of interviews with informants (see Table 1), participant observations, group discussions, meetings, workshops and training sessions, conducted between 2002 and 2004 at the MoH headquarters, the Coast region health office, and the Bagamoyo and Kibaha districts. In addition, analysis was performed on documents such as data forms and reports.

Table 8 Type and number of respondents interviewed

Health sector level	*Respondents*	*Number of respondents*
MoH	Managers	2
	Trainers	3
	Statisticians	2
Region	Information officers	2
	Managers/secretary	2
	System users	4
Districts (Bagamoyo and Kibaha)	Information officers	4
	Health managers/secretary	4
Health facilities (Bagamoyo and Kibaha)	Data compilers/collectors	10
	TOTAL	33

4. INTEGRATING USE OF TECHNOLOGY IN THE HEALTH INFORMATION SYSTEM IN TANZANIA

This section describes the case study of HIS relating to the integration of ICTs with HIS and the general application of ICTs in the health sector.

Since independence in 1961, Tanzania has made a remarkable progress with regard to the distribution of health facilities (85% of the population can reach a heath facility within a range of 5 or 10 kilometers). However, health services remain poor due to various reasons including lack of adequate skilled health staff and the presence of inaccurate and unreliable information unfit for decision making.

The Tanzania' MoH with assistance of funds from donor agencies and external consultants started the development of a paper based Health Management Information System (also called MTUHA in Swahili meaning "Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya") in 1989, followed by its country wide implementation starting from 1993 to 1997. The aim was to provide reliable information and integrate data from different donor funded disease specific programs (vertical programmes). The MTUHA was designed in line with the health administrative structure of four levels; the national, regional, district and health facility levels. The district is the main operational unit for the management of primary health care strategies and services. The national level (or the MoH) is responsible for health policy formulation and human resource development and the management.

4.1. Operation of MTUHA system

Data for the MTUHA is collected at the health facility from patients attending health services on a daily basis and reported to the district health authorities. The reporting frequency can be weekly, monthly, quarterly or yearly. The district health authorities manually integrate all health information within the district on quarterly basis and prepare a summary for sending to the regional level. At the regional level, the data are entered into the

MTUHA software to produce an electronic version on a diskette to send to the national level for national data analysis using the MTUHA software. Health facilities vary in terms of skills of health workers, infrastructures, quantity and quality of health services provided. A health worker at a health facility is provided with at least 12 different MTUHA registers (more than 666 data elements in total) for data registration. The same health worker is required to record different data in the registers of the vertical programmes such as Family Planning and Tuberculosis as certain data elements were missing from the MTUHA registers.

4.2. Data handling and processing at peripheral levels

Administratively, district health authorities take responsibility for data supervision and collection from health facilities. The data reporting is often delayed by one or two months and is also incomplete. For example, two private health facilities were identified that had never reported data in one of the districts visited. On the other hand, health facility authorities in some cases were forced to send data when they collected their salaries at the district office thus promoting unverified and untimely data reporting.

On one of the district visits, the district data information officer was just back from a one week trip to collect three (3) months over due data (December 2003 data). Despite such a delay, the district data information officer managed to collect data from 22 out of 37 health facilities. When asked about the remaining health facilities, he responded:
They will bring their reports when they come to collect their salaries. But even the reports collected have several deficiencies. As you can see some parts of reports are not filled in [he showed the reports] though they offer such services.
When asked about the cause of inefficiencies, he further replied;
I think it is because of little understanding. I have been there several times trying to assist them but they do not do any better. Again it is also because of negligence. This is just their character. You will see that there are some doctors who provide medical services to patients but do not put in record. This makes it difficult to calculate how many patients a doctor has attended this month. Or from beginning to the end how many patients a doctor has attended.

When asked about steps taken to solve the problem, he continued:
I collect the reports and learn the problems so that next time I may inform them. However, close supervision is needed but we have no time to verify data. In order to go deep we need to have enough time. The problem is that you have to visit a larger number of facilities per day which means there is no time to verify data. Since, we do not have time to audit data that gives them a chance of just filling the forms the way they want. You will have to spend like three (3) hours to verify the data. During the past, we used to go through each data. But if you employ this approach you cannot go more than two (2) facilities a day.

The lack of skills and knowledge for data handling is contributed to by the lack of training. Some of the health workers received only one training on filling in data registers more than 8 years earlier (during the introduction of the MTUHA) while others had no training at all. A few of the new health workers, just for the sake of job security, tried to obtain some instructions on how to compile data from the district data information officer. Indeed, most health facilities visited had no population data and there was no evidence of its use apart from information about medicine stocks and use. When the district health administrative secretary was asked to provide comments on the data handling procedures, he replied:
In order to improve data collection we need to ensure that heath workers are empowered by building capacity. The problem is that most of the time they are busy with issues of direct health services. And you know this is more an administrative issue. There need to be personal commitment and incentives. The issue of reporting is there but the only problem is that data is mostly reported very late.
Some of the health facilities were grossly understaffed; others had a maximum of two or three health workers who lacked time for data handling due to the pressure of providing health services. They regarded the data handling work as extra work that needed extra incentives which were not provided. When asked about missing data elements in the MTUHA registers, one of the national technical managers replied:
When the changes are introduced, it means a need to train individuals on those changes nationwide, which may take a long time and lots of financial and technical resources. It took more than two years for some individuals to understand how the current data register books and procedures work. Even though currently there are some regions, which have not been able to utilize them properly.
The MTUHA registers are often received more than five (5) months after the end of the year. This delay from the national level via the districts led to some health facilities using rough papers to record data which created inconsistent and unclear information. The districts visited in February 2004 had not yet received registers for 2004 and the reply from one of the district data information officers was:

Last year (2003) the registers were received late in May. These registers are being used now (2004). So the books entitled '2003' are being used for the year '2004'. We have contacted the MoH people but said they have not received the registers from the printing unit yet.
Although, the peripheral levels had some financial resources as well as computers and printers, they were not able to design and produce their own forms for data transcription, indicating a lack of skills and time. Thus, they are completely dependent on the national level that in turn depends on donors.

4.3. Integrating use of computer technology with MTUHA system

The computerization of the MTUHA was undertaken in 1992 by an external software consultant who developed Dbase software for the implementation and use at the national level and all 20 regions of the Tanzania mainland, while data handling at the district and health facilities remained manual. However, in 1997, the MTUHA system was changed through an initiative of a donor, whereby a number of changes were made. For example, new forms were introduced and the reporting frequency for health facilities was changed from monthly to quarterly. The MoH, with assurance of funding from the donor, contracted a local vendor to develop new software using the MS-Access database management system. The vendor delivered an executable version of the software, retained the source code and provided a 6-month period post delivery guarantee. However, bugs kept being identified even after 6 months of delivery implying that the MoH needed to find extra funds from donors every time to improve the system further.

The MoH lacked required skills, experience and expertise to participate in the development process and instead wanted ready-to-use software. The executable version of ready made software was handed over to the MoH and installed on some computers at the MTUHA unit. The vendor then provided an initial overview about the software to one of the unit's employees who was expected to train others. The HMIS unit then took responsibility for the overall activities related to the implementation, training, and user support despite the severe shortage of skilled and adequate human resources that existed in the unit at the time. Despite this, the unit installed the software at the regional level and provided only an overview of how to operate it in terms of entering data and generating reports. No additional training was provided (HERA, 2000).

When analyzing the skills of the staff working at the MTUHA unit, most (if not all) had a background in statistics and basic computer skills but not to the level required to deal with the complexity of ICTs. For such knowledge, the MoH had to hire external consultancy services, which was extremely expensive and short term.

4.4. Analyzing use of MTUHA software and computer technology at peripheral levels

Each health district has at least one computer with some of the regions having more than one. For example the Coast region had 5 computers and other accessories acquired through the MoH or donor support. However these were primarily used for secretarial services and not for HIS. When asked about the use of computers, the regional information officer replied:
We do not have an epidemiologist here. So if you could help us with making graphs that could help. Sometimes I want to show data on a graph but I find it difficult. People they know what they want from data but cannot use the computer to show or represent it.

The MTUHA software installed at the regional office was just a symbol used for producing an electronic version of data for the national level. No one had skills to explore or fix bugs (MoH, 2000; Boehning, 2002; MoH, 2002), or deal with the lack of technical support. For example, in one of the health districts, one computer had been put aside for more than five (5) years which the author suspected to have a hard disk problem. A similar case was found in another district where a nearly new computer that had no anti-virus software installed on it failed leading to a loss of all stored data. Although peripheral levels had some financial resources, they had no technical or managerial skills apart from some very basic skills (such as how to use MS Word). They also regarded a computer as something so advanced that it never had any faults.

Until recently, the peripheral level directly reported computer faults to the national level but most issues had been delegated to the respective level depending on their financial capability to hire someone from a private company for computer services and maintenance. However this approach received criticism for paying a lot of money for solving simple technical problems such as fixing cables and installing software. When asked about employing a permanent person for helping with technical problems, the regional health administrative secretary replied.
Currently the MoH want to have a manageable size of staff. In order to introduce a new professional such as IT that does not exist within the MoH, the department of civil servants must approve it. Otherwise later on we will

not be able to promote him. If we employ someone, he or she will just stay here for years without getting any promotion. ... It is important to know which department will deal with such people's promotion.

4.5. Introducing new HISP tools and approaches

The Tanzanian HISP team is composed of local researchers (in ICTs and Health care) and practitioners from the health sector who organize different on/off site training at various levels of the health sector involving different target groups such as health managers, data compilers and health workers. The health care professionals conduct participatory discussions towards improving HIS routine procedures, understanding of the meaning of data and use of information for decision making.

4.5.1 Human resource capacity challenges

The HISP team has faced challenges such as lack of appropriate human capacity coupled with the lack of time and presence of poor quality data. This has led to difficulty in implementing the user participation approach without initial training on computer use. Health workers lacked the skills and confidence necessary to engage in a participative process. At the facility level, the data handling process is carried out by health workers who have little or no background in statistics or use of computers. The district health information officers, apart from their engagement with the MTUHA system, were also responsible for providing direct health services and coordination of vertical programmes leading to work overload and fragmentation.

The HISP team organized the training on computer hardware and basic software skills (e.g. Word, Excel, and Access) which was then followed by training on the adaptation of the DHIS. The participation of health managers was not possible due to lack of time. Moreover, as a result of the lack of funding from the HISP and local institutional support, the training was only organized for the duration of 5 days, which did not give trainees enough skills and practice. The lack of health managers' participation made it difficult to understand in depth the actual district organizational needs and develop the necessary computer literacy.

Despite efforts to conduct training on computer literacy, there were some trainees who were not appropriate and who had different agendas which contribute to a waste of resources. In one of the pilot districts, one of the HISP members had to work out a long manager' list of trainees excluding those trainees who had no direct involvement with data handling. Only eight (8) of the listed trainees were eligible with the rest wanting to participate for financial gain rather than to learn and get skills. The plan was to have two separate training sessions, however, ending up in only one session. The afternoon session trainees did not show up because, "Some of our colleagues thought there were training allowances that's why they dropped out".

However, after the trainees received training they did not have time to practice and apply the skills they learned. For example when the author visited one of the pilot districts to evaluate the usage of the DHIS, the district data information officer who had received training and several support said:
All the data entered into the DHIS are needed but the knowledge to generate a general report is not yet clear. Also I do not have enough time to settle down and sit on the computer. I need to learn more...

5. ANALYSIS AND DISCUSSION

The case study has shown that health workers lack skills and time for training and practice as a result of unconducive working environments (Paul, 1995). Health workers collect the routine data out of habit and for the sake of satisfying their superiors' needs rather than using the data for action. They spend a lot of time dealing with large datasets, in filling in different registers of the MTUHA and in dealing with various vertical programmes that follow a data-led tradition. In contrast to the HISP philosophy of using small datasets and following an action-led approach to support local use of information (Sandiford *et al.*, 1992). If training was given, it was only once (not followed up) and was not effective (and not provided to the appropriate health workers), and thus health staff continued to face problems with data handling, interpretation and use of data for action, using computers and basic applications. However, even when health workers were trained they tended not to have time to utilize the skills acquired. The focus on training without practice resulted in a waste of resources and absence of mechanisms to ensure sustainability.

It was also evident that ICTs in the health sector had not produced any benefits due to poor data that were not appropriate for action and a lack of skills and knowledge. This means that health workers need a continuous and well developed training programme that starts with the basics (entering data and making reports) and builds up to advanced skills due to a general lack of skills about computers and data. However, although training initiatives are necessary to empower health workers with skills, such initiatives must also include processes of developing a

culture where information is valued and depended upon for action. Thus implies building new understandings and perceptions (through training and participation in action research) towards information and social values related to the collection, reporting and use of information. (Ingram and Clay, 2000). However, the creation of an information culture is not possible with the lack of active participation of health managers in the design, execution of new structures and understating of ICTs as illustrated by the HISP training example.

The available ICTs in the health sector continue to be regarded as primarily political symbols as a result of the lack of appropriate ICT literacy. This makes it difficult for health staff to utilize, maintain and sustain the ICTs or to understand their impacts in the performance of the overall health sector. Most of these ICTs are obtained through donor support and do not have any long term human resource policies or strategies to utilize or sustain them. Typically, during the development of the MTUHA software, donors provided financial support only during the first life cycle and both parties took for granted the availability of appropriate human resources in the health sector. The developer being paid directly by the donor developed the software in a closed room without transferring any skills to the MoH and deliberately retained the source code for further financial gains. Moreover, top officials from the MoH did not have enough skills (systems analysis or development skills) to foresee the impacts of donor policies, development processes or in the HIS operational activities.

The acquisition of ICTs in the health sector in short term training is not enough as it creates a great burden as a result of ineffective usage, lack of maintenance and failure to fulfill the promise of improved health services (Lippeveld, 2001).The capacity of existing human resources needs to be upgraded based on particular needs and work at each level of the health sector. This can be done through appropriate and well designed training and the creation of a conducive, enabling and open learning environment. However, this requires a long term perspective beyond the first life cycle support. It also requires support and a strong commitment from the MoH and the donors to continuously mobilize resources for sufficient training and building basic analysis and long term ICTs skills. The training needs to be viewed as a continuous process to allow workers to learn from practice and experiences and to respond to changes of ICTs (UNDP, 1994; Paul, 1995) at all levels of the health sector to facilitate a sustainable HIS.

Donors are quite diverse in terms of policies (time, priorities, and operations) and allocation of resources (Chilundo and Aanestad, 2003). Health care support is a priority of many international aid agencies given the poor health services and resources as well as epidemics such as HIV/AIDS, Malaria and Tuberculosis in LICs. By pooling resources together and combining policies to work out the problems of weak capacity in the health sector/LICs, donors could contribute better to the health sector. The donor funded vertical programmes could organize joint concrete training through combined resources (Paul, 1995) rather than having small pieces of uncoordinated, multiple short term training programmes with different objectives and incentives.

LICs such as Tanzania will continue to depend on donors both technically and financially, and thus ICTs will continue to be unsustainable as long as capacity building efforts are ignored. As ICTs continue to change, new needs will arise and thus new skills are needed. The local governments must develop and sustain their own human resources to effectively anticipate and respond to new ICTs and institutional needs without having to depend on external technical assistance. However, capacity building is more than just technical skills (such as trouble shooting, installation, updating etc.) since HIS also involves processes and practices (Gee, 1999). Thus, appropriate and adequate human and institutional capacity is needed in the area of information handling and interpretation, ICTs use and management (including skills in project management, and contract writing), in addition to database administration and systems development.

6. CONCLUSIONS

The creation of a conducive, learning, and adaptable environment is a priority to develop motivated and appropriate human capacities (Paul, 1995) which in turn requires joint efforts and long term policies of local governments and donors. Sufficient funding is needed to support long term training as long as people and institutions need new skills and knowledge in work processes and ICTs. The promotion of workers based on skills and efficiency would likely reduce the possibility of people participating in training only for financial gain. In-house training for capacity building is possible with some financial capacity and ICTs available at the levels of the health sector. However, the lack of policy guidelines makes it difficult for health managers to employ or contract ICT professionals for ICT support.

Human capacity building required in the health sector is more than just technical skills, but also about the meaning and use of the information for action. These demand a mix of skills to understand the meaning of data, information and ICTs. The skills of using ICTs are needed for a large number of people whereas skills in ICTs management and systems development are needed by a few people at each level who understand most of the

everything about ICTs. Thus, the required 'mix of skills' is radically different between different levels of the health sector depending on the individual level's needs, work practices and responsibilities. For example health workers and managers at the lower levels will have different skills requirements compared to the MoH officials who interact with donors, consultants and vendors.

Local institutions of training, research, and consultancy (universities and colleges) play long term and crucial roles in developing and upgrading human resource capacity (Braa *et al.* 2004). Donors could also seek to utilize qualified professionals working abroad (who posses particular ICTs skills) to contribute to knowledge and research in LICs in favor of foreign experts who often work on a temporary basis and lack contextual skills. However, when experts do work in LICs they should aim to develop local skills and knowledge and help support training for trainers.

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The Potential of District Health Information Software in Tanzania

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ABSTRACT

The paper presents quantitative and qualitative empirical data obtained in a one year research period while piloting the District Health Information Software (DHIS) in Tanzania. The DHIS is in different stages of implementation in several countries including South Africa, India, Malawi, Mozambique and Cuba. However, each country has its own unique needs that do not necessarily match with other countries. It is in this regard, was conducted a thorough evaluation of the DHIS in Tanzanian context in order to determine its potential in terms of user satisfaction toward the reliability and usability of the software. The results indicate that the DHIS software is a reliable and users find it ease to use. However, users need more data in the DHIS software in order to regard it as a health data analysis tool. The study methods contribute to the knowledge body of software end-user satisfaction evaluation research.

Keywords: District Health Information Software, Information Systems, Software Evaluation

1.0 INTRODUCTION

The World Health Organization (WHO) has identified Health Information Systems (HIS) as critical for achieving health for all. A report of a WHO meeting in 1987 clearly linked improved health management to improved HIS arguing that, "of the major obstacles to effective management, information support is the one most frequently cited"(WHO 1987). HIS generates information in order to inform health planners and decision-makers on what is happening at the health delivery facilities, and can potentially be made for better delivery of health services. Many HIS are now becoming more reliant on computer software to assist in health data compilation, collation and analysis processes, and potentially support functioning of health care organizations(Neumann et al. 1996; Raghupathi 1997). However, this potential can only be realized if the HIS can be successfully developed and implemented in a cost-effective manner.

Implementing a new system or changing an existing one may have a profound, effect on work and service processes. Because HIS is costly and involves a significant amount of staff time, it is important to evaluate these systems critically (Wyatt et al. 2003), and learn from ongoing experience in order to improve the utilization of existing systems. Evaluation research can help to examine the relevance of the system for the health care organization users(Schuring et al. 2002),(Friedman et al. 1997): to promote and encourage the use of Information and Communication Technology (ICT) by demonstrating benefits; allowing developers to learn from past success and mistakes. Evaluation is also an ethical and medical topic for researchers and helps develop health informatics as a scholarly profession.

Measuring HIS costs and benefits, productivity improvements, competitive advantage and the impact on decision-making is difficult to do in practice for various reasons, especially the long term impact of information on health delivery. To work around those difficulties, user satisfaction has received widespread acceptance as a surrogate measure for evaluation, and we use it in this study. Several models of software evaluation measurements and instruments were reported in (Häkkinen et al. 2003; Neilsen 1993; Sommerville 2001). In this study, we concentrate on satisfaction results and examine factors related to user satisfaction.

The paper is organized as follows: Section 2 describes theoretical perspective on software evaluation in general and user satisfaction in particular. Section 3 describes research methods and hypothesis. Section 4 presents the case study and data collection methods. Section 5 presents data analysis and discussion. The study conclusion is presented in Section 6.

2.0 THEORETICAL PERSPECTIVE

2.1 Computer Software in Health Information Systems

There are various benefits of using computers in health information systems. For example (Sommerville 2001) argues: to improve health system efficiency by processing and analyzing large amounts of data quickly; to produce a wide variety of outputs and feedback reports targeted at many levels of the health system from a single data set or by combining data sets; to reduce the duplication of work contributed to by multiple hierarchical data collection systems; to improve the quality of data collection; preparation of immediate feedback reports on errors for individual health facilities; to improve analysis and information presentation to facilitate data interpretation and use for decision-making; to train health personnel through computer-based interactive tutorials for self-instruction and continuing education; and to improve data dissemination by providing online public access to data through Internet World Wide Web pages (Sommerville 2001). In addition to these reasons for using computer technology in HIS, the process of computerization itself can serve as an opportunity to review and improve dysfunctional manual systems and procedures (Auxila et al. 1988).

However, the manner in which ICT is implemented in HIS in developing countries has been questioned by many studies. Lippeveld and Sapirie argue that the primary emphasis on computer of many typical HIS tends to marginalize the more important purpose of serving the data needs of the care providers (Lippeveld et al. 2000). McLaughlin (McLaughlin 2001) argues this technology dominated focus has contributed to the production of notorious white elephants and countless reams of paper forms which are often irrelevant for decision-making. This emphasizes the need for critically evaluating HIS projects, and how well they serve the data needs of different users. In the next section, some key concepts from evaluation research are presented.

2.2 Evaluation Research

Evaluation research refers to the systematic collection and analysis of information in order to support decision-making concerning projects, processes or methods (Häkkinen et al. 2003). Evaluation needs to be highly pragmatic in nature, through gathering reliable and valid information and determining the value of the findings in comparison to the criteria (Rossi et al. 1993).

There are several ways to approach evaluating HIS, and comparison is a key component of the process. The system can either be compared with the previous system that was replaced or with respect to present objectives (Ammenwerth et al. 2000). The evaluation method will depend on various factors such as the current software lifecycle stage and what aspect of the system is being considered. Evaluation can be formative or summative. Formative evaluations are usually conducted early in the systems lifecycle and usually concentrate on process rather than product while summative evaluations assess software program outcomes or impacts.

HIS evaluation can be approached from either an objectivist or subjectivist point of view. The objectivist approach uses measurable data that is interpreted through statistical applications (Ammenwerth et al. 2000); while a subjectivist approach focuses on description and explanation derived from observation and interviews (Friedman et al. 1997). The subjective approach allows the evaluator the flexibility to change the study as it evolves because it assumes that as evaluation proceeds, new questions and perspectives may emerge that require further investigation.

Determining the evaluation type (formative or summative), evaluation approach (objective or subjective) and evaluation criteria to be used in an HIS evaluation depends upon many factors including what type of system is being evaluated, who the stakeholders are, what methodology is being used and what financial or time constraints need to be considered. HIS evaluation criteria should include criteria that cover both the technical aspects of the system as well as the impact the system has on the environment in which it exist. Evaluation needs to consider technical attributes of the application including efficiency, efficacy, reliability, usability, learnability, and impact to society (Neilsen 1993; Sommerville 2001). Evaluation studies have been carried out using different data collection methods: simulation, questionnaires, interviews, observation, logging actual use of software, retrospective testing, focus group discussions etc. Häkkinen et al. describes a current shift in emphasis in evaluation from managing the data of individual patients towards management of organizations and their relationship with customers(Häkkinen et al. 2003). This shift emphasizes the need for organizational measurements, which require multiple strategies, using both objectivist and subjectivist approach (Ammenwerth et al. 2000; Friedman et al. 1997).

In this study, we adopted summative evaluation as we were assessing the software in its deployment phase. Hence we were studying the outcomes and impact of the software in its health care organization. Our evaluation is also subjective. This is because we reviewed the process as we studied the system. For example, when we study a certain phenomena, through interview, we find conflicting information and thus need to conduct observations and apply other data collection methods. In the next section we describe the framework adopted for the research.

3.0 RESEARCH MODEL AND HYPOTHESIS

Our research model pays attention to the fact that evaluation of software needs to consider reliability and usability factors in order to determine user satisfaction with the software, see (Häkkinen et al. 2003; Neilsen 1993; Sommerville 2001). User satisfaction is associated with user and software characteristics. User characteristics include factors such as age, education level and computer literacy of end-users(Barki et al. 1994; Winston et al. 2000). Software characteristics includes aspects of content, accuracy, and failure rates (Mayhew 1999; Neilsen 1993; Pan 1999; Sommerville 2001). In this study we consider both user characteristics and software characteristics. Figure 1 describes the conceptual model adopted in the research which describe that user satisfaction is influenced by software characteristics and user characteristics.

3.1 User characteristics

In this study, we examined three user characteristics: age, education level, and computer literacy. Older people are more likely to fear new technology and be hesitant to change (Winston et al. 2000), while young professionals might be easily satisfied by computer solutions (Häkkinen et al. 2003). This leads to the following hypotheses:

H1: user satisfaction is greater amongst young users as compared to older ones

H2: user satisfaction correlates positively with education level

H3: user satisfaction correlates positively with computer experience

3.2 Software characteristics

Health care organizations acquire software either through purchasing as a generic software product, or through bespoke software development. Generic software typically represents stand alone software produced by a vendor and sold in the open market. Once sold, generic software users typically receive limited or no support from the vendor. Bespoke software is customizable, which is commissioned by a particular customer to fit particular user requirements. Users of bespoke software tend to receive special training and support from the development organization. In this study, software characteristics were regarded as software performance (accuracy and failure rates), training and support, content and report formats

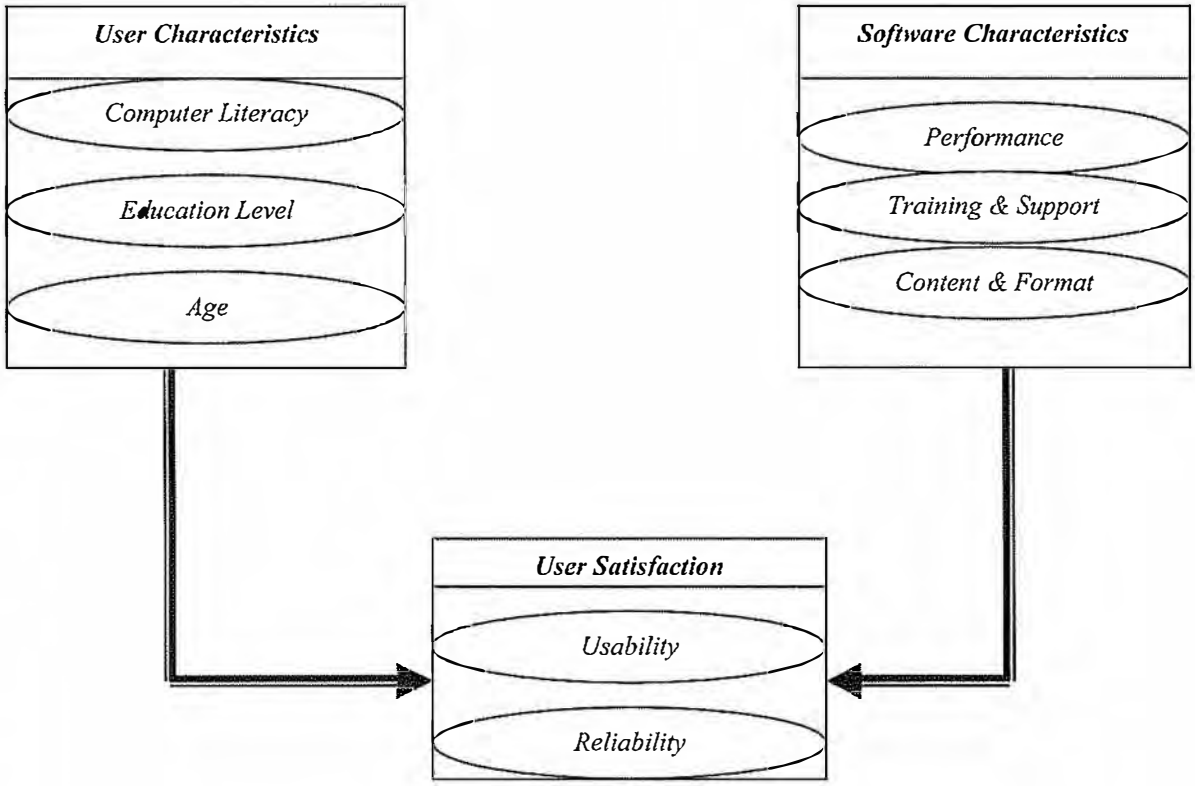

Figure 16: A Model of Software End-User Satisfaction

According to the American National Standards Institute (ANSI), Software reliability is defined as the probability of failure-free software operation for a specified period of time in a specified environment(ANSI/IEEE 1991; Lyu 1995). Pan(Pan 1999) argues that, software reliability is different from traditional hardware reliability in that software reliability is not a function of time. Electronic and mechanical parts may become old and wear out with time and usage, while software will not rust or wear out during its life cycle. Software will not change over time unless intentionally changed or upgraded(Pan 1999).

Sommerville argues that, interface evaluation is the process of assessing the usability of an interface and checking that it meets user requirements(Sommerville 2001). User interface evaluation is always conducted against usability specifications based on learnability (how long does it take a new user to become productive with the system?), speed of operation (how well does the system response match the user's work practice?), robustness (how tolerant is the system of user error?), recoverability (how good is the system at recovering from user error?), and adaptability (how closely is the system tied to a single model of work?) (Neilsen 1993; Sommerville 2001).

4.0 RESEARCH SETTING AND METHOD

4.1 Case Study Setting

The health and management information system (HMIS) in Tanzania has four organizational levels of health data processing: health facility level, district level, regional level, and national level(MoH-TZ 2000). In Tanzania, both private and government owned health facilities are required to report health data to the national

HIS. A health facility compiles health data collected at the health units and from outreach activities including home based health delivery services. Reporting of health data flows as described in Table 1:

Table 9: Data flow in the HIS in Tanzania

Name of Report/Form	Frequency	From	To
HF Staff listing form	Annual	All health facilities	District Medical Office
Equipment inventory form	Annual	All health facilities	District Medical Office
Physical structure inventory form	Annual	Government health facilities	District Medical Office
Health facility annual report form	Annual	All health facilities	District Medical Office
Health facility quarterly report form	quarterly	All health facilities	District Medical Office
Renovation/Maintenance report form	Annual	Government health facilities	District Medical Office
Equipment breakdown report form	Annual	Government health facilities	District Medical Office
Notifiable disease report form	weekly	All health facilities	Regional Medical Office
District quarterly report	Quarterly	District medical Office	Regional Medical Office
DMO Staff listing form	Annual	District Medical Office	Region
Regional quarterly report	Quarterly	District medical Office	Ministry of Health
RMO Staff listing form	Annual	District Medical Office	Ministry of Health

In January 2002, the University of Dar-es-Salaam (UDSM) in Tanzania and the University of Oslo (UiO) in Norway initiated a long term programme to implement computer software at district medical offices in Tanzania. A formal memorandum of understanding was signed in 2002 between University of Dar-es-Salaam, University of Oslo and the Ministry of Health in Tanzania to implement the research project and a computer software solution known as District Health Information Software (DHIS) within the broader framework of the Health and Information System Programme (HISP) network. The DHIS software has been successfully implemented in South Africa(Braa et al. 2002) and is now being tested and piloted in different countries including Mozambique, Malawi, Ethiopia, and India. The HISP Tanzania team is composed of computer science and health professionals from higher learning institutions, namely the Department of Computer Science, University of Dar es Salaam and Department of Community Health, Muhimbili University College of Health Studies.

This study evaluates user satisfaction toward the DHIS software in Tanzania, within five pilot districts: Bagamoyo, Kibaha, Ilala, Kinondoni, and Temeke. Usually there is only one key person responsible for collecting, collating, compiling and analyzing health data at the district level. Thus, for the DHIS, there is only one potential user at the District level. However, in each district, three personnel were selected to be trained to use DHIS software (a total of 15 end users) in order to broaden the user base and thus contribute to sustainability. The study also included three District Medical Officers from the pilot districts in order to elicit views of health managers. Thus, a total of 18 respondents were included in the study.

4.2 Data collection methods

In this study we assessed user satisfaction toward two software attributes: reliability and usability. For the purpose of data analysis, five scales were introduced: accuracy, failure rate, training and support, content, and format. The first three measure reliability factors and the last three measures usability factors as presented in Table 2.

Table 10: Applied Evaluation Criteria

User Satisfaction Factors	Scale	Rationale
Reliability	Accuracy	Measures accuracy of the output of the system
	Failure rate	Measures the frequency of failure of the software
Usability	Training and Support	Measures effectiveness of training and supports delivered to users which contribute to learnability
	Content	Measures adequate coverage of information
	Format	Measures clarity of software reports

All scales were of 7-point semantic differential type adopted from Chin and Lee's proposed model and measurement instrument for the formation of Information Systems satisfaction (Chin et al. 2001). Scaling of seven intervals on each scale was quantified by assigning the values -3, -2, -1, 0, 1, 2, and 3 to the intervals. Data collected from other methods (retrospective testing and field observation) were transcribed and encoded and fitted in to the five scales as presented in Figure 2. That is, user reaction toward the software was analyzed in different dimensions: through the questionnaire, from observed data, and actual use of the software, then a point from the 7-point semantic differential was selected.

Very Dissatisfied			Neither			Very Satisfied
-3	-2	-1	0	1	2	3
?	?	?	?	?	?	?

Figure 17: 7-point semantic differential

We use the concept of summated scales, which are formed by combining several individual scales into single composite measures. All high scales loadings on factors are combined, and the average score of scales is used as a replacement scale. Total user satisfaction was obtained by averaging the scores on the 5 scales. In addition, excerpts from coded subject's interaction with the DHIS software were included to enrich qualitative analysis.

Data collection took place from July 2003 to August 2004 via a combination of qualitative methods: retrospective testing, questionnaire and fieldwork observation (Mayhew 1999; Neilsen 1993) these are now described:

Questionnaires: self-administered questionnaires were distributed to all 18 subjects. The questionnaire had two main parts: subject profile (age, education, computer literacy) followed by five questions measured using the 7-point semantic differential. User age was classified into two categories: under 40 and over 40. Education was classified into three levels: secondary school certificate, college certificate/diploma, and University advanced diploma/degree. While many health staff in Tanzania have never worked with computers, all subjects in this study have been introduced to work with computers while working with the DHIS software. Thus, computer literacy was classified into three categories: beginners, over one year experience, and computer certificate holder or higher.

Retrospective testing: this evaluation method is applicable in the design, coding, testing, and deployment stages of the software lifecycle. It covers efficiency, effectiveness and satisfaction usability issues through quantitative data. A videotape is often made of a usability test session, and the tester(s) can collect more information by reviewing the videotape together with the user participants and ask them questions regarding their behavior during the test. The use of this technique requires the user's interaction both during and after the recording section. All HISP Tanzania training workshops were video taped, and in the last day of each training session users were tested on the skills acquired. Data from these video tapes contributed to a large part of the analysis.

Fieldwork observations: Neilsen describes that in field engineers go to representative user's workplace and observe them work, to understand how they are using the system to accomplish their tasks and what kind of mental model the users have about the system. This method can be effectively used in the testing and deployment stages of the software. This is the most detailed method used in this study. Each month, a HISP Tanzania staff visited the DHIS pilot sites to observe users and document their actions. Several non-HISP members also paid visits for observations purposes and their findings are also included in the analysis. It is this data that is included in this paper.

5.0 DATA ANALYSIS AND DISCUSSION

Results are presented in descriptive statistics and qualitative excerpts of encoded user reactions during interviews and retrospective testing. Study respondents' ages were divided almost equally with 56 percent under 40 years old and 44 percent over 40 years. Most respondents have not acquired a university education, only 33 percent had university education. In this study, 39 percent of the users had acquired formal computer training (had a certificate or more in computer training); detailed analysis of user characteristics is presented in Appendix I. Quantitative results indicate that respondents have rated the reliability of the DHIS with an average of 2.11 points of user satisfaction out of 3 points (total satisfaction). Usability of the software scored 1.70 points out of 3 points - indicating that many users found the software difficult to use. Table 3 presents quantitative results and detailed analysis of the results follows.

Table 11: Descriptive Statistics of User Satisfaction (US) Factors

US Factors	Scale		Minimum	Maximum	Mean	Average Mean
Reliability	Accuracy		0	3	1.89	2.11
	Failure Rate		1	3	2.44	
Usability	Training and Support		3	3	2.61	1.70
	Format		-1	2	1.61	
	Content		-2	3	0.89	

5.1 Reliability of DHIS Software

One of the key issues in HIS is to look at how the software has accommodated the paper based HIS processes. In our case, we were particularly interested to see how the DHIS has accommodated processes and hierarchy of the HIS in Tanzania which has four health administrative levels. The DHIS software was developed based on the South African HIS structure which has five levels namely health facility, district, region, province, and national levels. To work around this structure difference, HISP Tanzania introduced a dummy level, known as "zone level" which is above the regional level and below the national level. By introducing this dummy level the structure of the HIS in Tanzania mimicked that of South Africa, an important phenomena for configuring the DHIS. The importance of keeping structure on the DHIS software is to enable users at different level, to get access to the data they are working with. For example, DHIS users at district level would prefer to see health data from their own district instead of accessing information from all districts in the region. Those at the regional level would like to access all health data from the districts under their region.

Another aspect of reliability is to see if the DHIS software accommodates the information needs of the health workers. Specifically we looked at what extent the DHIS software computerizes all health data being collected at the district level. There are various information systems at the district level such as TB/Leprosy system, Expanded Programme of Immunization (EPI), Infectious Diseases Week Ending (IDWE), Malaria Programme, and the routine health and management system. In an interview, one user commented that,

"*No EPI data set, no HIV data, it is missing a lot of information*".
(DHIS User, Bagamoyo district, February 17, 2004)

As presented in Table 3, users seemed dissatisfied with DHIS in terms of its content (coverage of data sets), content scored the least average value of 0.89. However, HISP Tanzania team members insist that, the DHIS software is piloted to accommodate routine health data (data being reported by health facilities through national HIS registers). Information being collected at the health facility level can be categorized into two groups: routine health data and annual health data. Routine health data are those data being reported periodically during the year. I Tanzania these data are reported quarterly. Annual reported data are those being reported once per year. The DHIS again was designed to capture health data on a monthly basis. To work around this problem, HISP Tanzania team agreed to instruct DHIS users to enter quarterly reported data in March, June, September, and December for quarters 1, 2, 3 and 4 respectively. To accommodate annual data such as health facility infrastructure (hospital beds, cars, tables, staff), population data with different age groups and coverage level (e.g. district population, health facility catchments area population), the DHIS captures these data in a special form called "semi-permanent data" which are updated annually.
In real practice, a health facility can be opened, temporarily closed, re-opened, and closed permanently. This has to be reflected in the DHIS software. While registering a health facility in the DHIS software, users are provided with options to indicate whether that health facility is active (reports health data) or passive (does not report health data). In doing so, the DHIS has reflected and accommodated the actual status of a health facility.

Indicator definitions and calculations are the most tedious activities while working with paper based systems. Consider a district which has two hundreds health facilities and assume that all health facilities have submitted their reports for a particular year. In order for the District Health Statistics Officer to prepare the annual report, they need to calculate some district health indicators. For the HMIS in Tanzania, there are over eight district based indicators. One important indicator is Antenatal Clinics (ANC) clients as percentages of all births (total ANC clients divide by total births multiply by 100%). In a manual system, the District Health Statistics Officer has to sum all ANC and birth cases reported quarterly from each health facility report. The DHIS software has automated this process and produces a display report in a Microsoft Excel Pivot table (as in Figure 3) which allows the user an opportunity to filter displayed data and create graphs.

5	Coastal Region					
6	Bagamoyo					
7	(All)					
8	2002					
9						
10			mPeriod			
11	IndShort	IndType	Jun	Dec	Mar	Grand Total
12	ANC per delivery	%	105.60	108.30	120.74	113.29
13	ANCTT2+	%	83.66	83.15	64.32	74.04
14	BCG coverge	%	9.20	8.17	14.68	6.41
15	Children underweight	%	12.15	32.04	6.36	14.64
16	Measles coverage	%	6.84	9.01	13.96	5.96
17	HF reporting rate	%	57.14	57.14	57.14	57.14

Figure 18: Health indicators calculated using the DHIS Pivot tables

Analysis of interviews and field observations empirical data indicate no single failure (crash) of the software reported. However, some bugs were frequently reported but according to the HISP Tanzania supporting team, most of the bugs were categorized as novice user's bugs. For example, one user has reported a bug that the software could not export data to a text file, only HISP Tanzania staff discovered that the user did not specify a set of data elements to be exported and thus the software was not able to export the empty data set. Accuracy of the software reports is also reflected on the user satisfaction analysis which indicates that users seem to be satisfied with the accuracy of the software (as described in Table 3) where a 1.89 average points of user satisfaction was obtained.

5.2 Usability

As Sommerville described learnability aspect in evaluating software user interface should answer the question "how long does it take a new user to become productive with the system?" (Sommerville 2001). All HISP Tanzania training workshops lasted for one week (5 working days) followed by two days of on site training and support every month. While asked whether those HISP Tanzania training workshops are effective, most users seems to be satisfied with the training and support from the team (see Table 3). Training and Support scored the highest user satisfaction average value of 2.61. Analysis from interview empirical data indicate most DHIS software trainees complained that one week is too short for new users to become productive with the DHIS software.

"5 days HISP Training Workshop is not enough, more training days are required"

(User comment during Dar es Salaam HISP Training Workshop, July 1, 2004).

Though HISP Tanzania Training and Support was rated as more effective, most users feel incompetent in working with the DHIS. In retrospective testing, users demonstrated the ability to register a new health facility, key routine health data and generate standard reports on the last day of the training sessions. Working with advanced features like indicator definition, creating new data element and working with Microsoft Excel pivot tables were more slowly adopted during onsite training and support sessions.

Interesting conclusions were reached regarding the educational background of the DHIS users in determining necessary skills required for a health worker to use the DHIS software. The empirical data indicate that even less-privileged health workers in the lowest professional category were able to be trained to use the DHIS software. In Bagamoyo district, one health staff who was working with the district medical office on a temporary basis due to low qualifications of her education background, has acquired recognition and upgraded her workplace after training on the DHIS software. However, staff with computer literacy have demonstrated the ability to learn the DHIS software faster than their colleagues, as demonstrated by users from Ilala and Temeke districts in Dar es Salaam region. Table 4 presents Kendall's coefficients correction analysis performed for testing the Hypotheses.

Table 12: Hypotheses testing results using Kendall's tau_b coefficients of correlation

User Satisfaction		User Age	Education Level	Computer Literacy
Usability	Correlation Coefficient	.223	.464*	.639**
	Sig. (2-tailed)	.312	.026	.002
	N	18	18	18
Reliability	Correlation Coefficient	-.356	-.492*	-.277
	Sig. (2-tailed)	.134	.028	.216
	N	18	18	18

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Testing the hypotheses, user age is not positively correlated with user satisfaction toward the software attributes (usability and reliability). There is a slight correlation of 0.05 significant between user satisfaction and their education background. Computer literacy plays a big roll in user satisfaction toward ease of use of the software (see correlation significant of 0.01). Users with computer backgrounds were found to learn new software faster than those with no computer background.

6.0 CONCLUSION

In this study, we investigated user satisfaction toward the DHIS software regarding two variables: reliability and usability. Our results show areas of low DHIS satisfaction with usability. Some health data sets are still missing in DHIS. Since users are still not competent in using the DHIS to add missing data elements, they perceived the DHIS content is insufficient. We therefore recommend more training on how to use the DHIS software. Also populating the DHIS with more data sets is a crucial step in resolving missing information. This study methodology is in itself a contribution to the body of knowledge on software evaluation research. We further confirmed in agreement with previous research that software failure rate, accuracy, content, and user support are perceived by end-user as being important factors in software reliability and usability.

The disadvantage of the Health Information Systems is a serious shortage of health works. This paper contributes a model for evaluating HIS implementation and use, contributing a means of improving human resources through the use of ICT in health sectors where health workers may improve their performance through the use of ICT tools like the District Health Information Software (DHIS).

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APPENDIX I: ANALYSIS OF USER CHARACTERISTICS

Table 1: User Age

Characteristics	Frequency	Percent
Under 40 Years	10	55.6
Over 40 Years	8	44.4
Total	18	100.0

Table 2: Education Level

Characteristics	Frequency	Percent
Secondary School Certificate	5	27.8
College Diploma	7	38.9
University Advanced Diploma and higher	6	33.3
Total	18	100.0

Table 3: Computer Literacy

Characteristics	Frequency	Percent
Never Used computer	5	27.8
Over 1 Year Experience	6	33.3
Acquired Computer Certificate	7	38.9
Total	18	100.0

National Human Resource Development Policy for Software Exports: Case Evidence from Costa Rica

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ABSTRACT

Software industry development is acknowledged as an important engine of economic growth for many less developed countries. The role of national policy has been identified as a catalyst to software industry and software exports development. Software development is a service that is both labour and skill intensive thus an important aspect of related policy is concerned with provision of appropriately educated and trained human resources in sufficient quantity. This paper provides an analysis of human resources issues facing policymakers in less developed countries engaged in software exports policy formulation. The complexities are highlighted through the case study of Costa Rica where there is an ongoing strategic planning effort to increase software exports.

1. INTRODUCTION

Software industry development is acknowledged as an important engine of economic growth (Kambhampati 2002). Recognizing this potential, stakeholders in many developing and transitional economies (DTEs) have become actively interested in developing the software industry sector, particularly exports (Al-Jaghoub 2004, Carmel 2003). High profile success stories of India and Ireland have contributed to this growth in interest. A 50% growth of software firms in India has led to a 3% contribution of the software sector to the gross domestic product. Similarly, in Ireland there was more than a doubling of numbers of software firms during the nineties. The growth in both countries had significant implications for employment generation, for example the Indian industry is reported to employ about 250,000 people with predictions of large future expansion, especially in the IT Enabled Services sector. The growth in the software sector in India has contributed to productivity spillovers in other service companies and demonstration effects to other sectors (Arora et al 2001).

The role of national policy has been identified as an important driver of software industry and software exports development in both DTE and developed country contexts. For example Kambhampati (2002) describes the important role of policy measures in India and Watson and Myers (2001) discuss how policy has stimulated growth in Finland's software industry. Supporting the creation of an appropriate "educational capital" is a challenge for policy makers to address to capitalize on opportunities. However, many developing countries are constrained by access to computers and Internet, English literacy and an educational curriculum that often tends to emphasize technical skills over critical thinking and management competencies (Kambhampati 2002 p25).

The aim of this paper is to analyse some of the complexities DTEs face in software exports policy formulation with a focus on human resources. These complexities are highlighted through the case study of Costa Rica, a nation where a strategy process is underway to strengthen its software export sector. The learning gained from this analysis can provide insights to other countries at a similar stage to Costa Rica in order to evaluate their strategic options with respect to human resource issues.

The rest of the paper is organised as follows: in the next section we present a theoretical framework related to software exports policy and the role of human resources. In sections 3 and 4, the research methodology is presented followed by the Costa Rican case study and analysis. Section 5 is comprised of a summary of the analysis, some conclusions and implications.

2. LITERATURE REVIEW AND THEORETICAL FRAME

A software industry is human resource intensive and shaped by various issues including scale, costs, technical and managerial skills and skills availability. The software sector can be viewed as consisting of a "spectrum of labour" meaning the skills and qualities of human resources. The high end of the spectrum consists of very capable individuals sometimes known as "talent" who have critical thinking and problem solving abilities related to customised IS development projects; analysis and design, project management activities and the development of technical products. The lower end of the spectrum represents those with skills that can be learned in a relatively short period of time such as rudimentary programming (Carmel 2003). Activities requiring skills at different levels of the spectrum thus require concomitant human resource development strategies. To illustrate this, in the following sub sections we briefly highlight key features of the strategy adopted by three relatively successful software exporting nations (India, Israel and Ireland) and the concomitant human resource initiatives.

A majority of the initial software work in India up to the early 1990s was of the type derogatively called 'body-shopping' whereby the developers would go to the client site (mostly in the USA) for the length of the project. Work done in India at that time tended to be at the lower end of the spectrum such as coding operations and maintenance. While the initial challenge was addressing the required quantity of qualified staff, undertaking more complex and higher value added work for clients needed different kinds of skills for example, foreign languages and project management. This was important so that the industry would be sustainable and not subject to easy substitution with new entrant suppliers in other countries. Therefore, human resource policy measures needed to address these two facets of quantity and higher spectrum skills. The industry tried to meet this challenge by recruiting engineering rather than only computer graduates for software jobs. A number of universities also started Masters, Diploma and subsequently Bachelor level courses in computer applications. A number of training institutes like NIIT and Aptech played an important role in providing skill-based training which to some extent helped to fill the gap caused by the inertia of university bureaucracy to revise curriculum in line with fast changing industry demands. Education programs geared to the especial "high spectrum" needs of global software work, such as related to project management, marketing, finance, and team working in conditions of cultural, temporal and spatial diversity are hard to find in India with a few notable exceptions such as IIM Bangalore (Arora et al 2001).

Israel's specialization in products for Internet security and the communication sector was fuelled by military-trained computing graduates who after completing their service would enter into a flourishing civilian computing sector. Jewish immigrants with scientific expertise who came from the Soviet Union between 1989 and 1991 provided another engine of human resource growth. The output of computer science graduates was expanded to meet the demands for a "high spectrum" educated workforce of sufficient quantity. Research institutions were provided with significant incentives to form linkages with industry, and the curriculum content was designed keeping in mind the criteria of relevance to the private sector. This link also provides mechanisms through which ideas generated can be commercialized and creates a vibrant structure to move from "invention to innovation." An interesting example of efforts to stimulate collaborative R&D networks is the Bi-national Industrial Research and Development Foundation (BIRD) established in 1977 in collaboration with the United States (DeFontenay and Carmel 2002).

With regard to Ireland, O'Riain (1997) traces the foreign direct investment driven growth of the Irish software industry after 1973 when major multinational corporations were attracted by the Irish Industrial Development Authority's policies of financial incentives and significant investment in education and telecommunications. Unlike India, Ireland avoided reliance on contract programming or body shopping. Instead, many large multinationals were encouraged to locate in Ireland by the ready availability of high spectrum skilled staff. Trauth (1999) discusses the specifics of how the Irish educational system was aligned with the skills needed by the "handpicked" multinational companies. Equality of access to education was established in 1968 and two new Universities were established in the 1970s and 1980s with a technical, vocational curriculum. Traditional universities were adapted to incorporate business and IT skills into the curricula and technical colleges were established around the country. Finally, adult evening classes were established. The government also sponsored training programs for those with a University degree but without requisite skills for work in the IT sector. The Irish government thus made focused attempts to scale up the numbers and capacities of computer science education programs and also increased their diversity by setting up joint degrees where computing was combined with foreign languages. Incentives were also provided to attract the Irish diaspora to return to their home country, especially from North America.

The three brief examples presented help to infer how human resources strategies vary with the industry focus. We present this interpretation in Table 1 below. Newly aspiring countries need to interpret the strategies in the particular historical context within which they evolved and how the changing situation today requires a radical rethink of what may work and how difficult it is to implement in practice. We discuss this in relation to our empirical investigation in Costa Rica.

Table 1: Relation Between Skills And Human Resources Strategies

Spectrum of labour	Role / skill	Human Resource Policy
High spectrum	Project manager Business analyst Systems analyst Foreign languages	University-R&D Linkages University–private sector linkages Joint degrees Focused incentives Attracting diaspora Enhancing numbers, quality and capacity of computer science programs
Low spectrum	Coding Testing Data processing	Computer language training Role of private training institutions Increasing number of colleges and programs Attracting graduates from non-computer science backgrounds.

3. RESEARCH METHODOLOGY

The authors were invited to support the Costa Rican government efforts of developing a strategy for enabling software exports in an "action research" framework (Baskerville and Wood Harper 1996). We developed a plan for the empirical work after conducting a literature search of the Costa Rican software industry. The authors visited San Jose for 3 weeks in August 2003 and during this period, a total of 18 interviews were conducted covering a wide range of stakeholders in government, universities, private sector companies; aid organization, financial institutions, trade associations and other officials from various government and semi-government organizations involved in marketing and promoting the software industry. Interviews were primarily semi-structured. These interviews provided a platform to develop greater awareness about the importance of a national strategy and the aims and objectives of our study. In addition to the interviews, two focus group sessions were also conducted, one with representatives from the private sector and the other with university staff. In addition, one large national level workshop was held on the topic of global trends in the software sector. This workshop provided the platform to bring together various stakeholders from the industry, government and university sectors in order to provide a broader awareness and gain their "buy in" to the strategy formulation process. In addition, we conducted three smaller and more focused workshops on identified themes relevant to policy formulation and implementation. In Table 2 below, a summary of the various sources of data collection are summarized.

Table 2: Summary Of Data Collection Sources

Data collection mechanism	Number of meetings
Interviews	18
Focus Groups	2
Workshops	4

A guiding frame of reference towards the interviews and their interpretation was the Software Exports Success Model (Heeks and Nicholson 2004) that emphasizes the importance of creating synergies between a complex range of interconnected factors such as national policy, education, infrastructure and international demand. Data analysis took place through a process of extensive discussion between the authors and with the various stakeholders responsible for the design and implementation of the national strategy. A report was presented to them on conclusion of the study and the feedback received on it provided further useful inputs to the analysis.

4. CASE STUDY

The Costa Rican software industry is relatively recent and in 2002 consisted of about 100 firms, 75 % of which could be classified as small and micro firms implying that nearly two thirds of the firms have less than 20 employees. Only 5% have more than 100 employees. The overall revenue of the industry was estimated at about US $ 170 million, about 60% of which was exports primarily to Central America and Mexico. The sector employs between 3,500 - 3700 persons, majority of whom are graduates from public universities. When focussing on human resources, a number of issues were identified in our study that reflect both the quantity and quality of human resources.

4.1 Quantity: The Problem Of Scale

Micro-sized firms experience serious problems, especially when they try to scale up from less than 10 to about 20 persons and the owners need to adopt management roles in addition to the technical. This problem was described by a chief officer of a software firm who had grown over a decade from a "one-man in a garage" start up to about 100 people:

"A challenge is when a company tries to move from micro (less than 10 people) to mini and small scale. The companies are not specialized to handle the management issues that arise and they don't have the people to do that".

While growth in size often came with increased opportunities of exports, this was also accompanied with the challenge of lack of specialized human resources, for example related to financing and marketing. A manager of a small software company said:

"We know it is easier to sell locally, because of geography. It is easier for large firms to sell overseas because they have the money. We have problems in marketing, as we do not have the resources to hire specialized managers."

Another aspect relating to scale was the absence of IT parks that could provide a cluster of geographically co-located software firms. Such clusters enable sharing of knowledge, experience and resources. Also clustering IT firms alongside Universities, or priority sectors in Costa Rica (biotech or new materials companies) provide the potential for development of cutting edge applications and resultant patents. The increased scale that a cluster naturally provides allows firms to share resources for common activities like training or quality control that in the longer run could contribute to developing human resource capacities.

4.2 Quality Of Human Resources

Quality of people is crucial given the knowledge intensive nature of the software development activity. The potential to export is dependent on the quality of the university graduates that enter the work force. Three key issues were identified as contributing to quality:

- weak university-private sector linkages
- poor English language capabilities
- inadequate management capabilities of technical staff.

Weak University-Private Sector Linkages

Contributing to weak linkages were a number of factors including poor intellectual property (IP) laws, the inertia of the university structure in responding to industry demands, a weak culture of applied research, and a lack of critical mass of researchers interested in supporting the processes of software exports. A senior manager of a private sector firm described how the links between his company and the university were steadily decreasing because of the weak laws of the university to support IP, and the reducing availability of funds to support long term research desired by the university:

"The intellectual property laws are poor and it is hard to keep secrets as there are no patents...While we are interested in applied research, we do not have the funds to support long-term research. So, we are looking at internships rather than PhD kind of research".

However, while establishing student internships was relatively easy to establish, they were difficult to sustain because of the short period of internships limiting the production of useful outputs. A manager of a small firm described this problem:

"Interns need a lot of supervision, and by the time they become able to contribute, they are ready to leave. It was different with some interns we had from Canada; they were ready to contribute right from the start".

While it appeared that interns from foreign universities like Canada were better equipped than the local students to contribute to the work of the companies, there existed no formalized and institutionalized structure within which these linkages could be sustained. Another issue with internships was the university laws that made it difficult for private sector people to use public resources such as computers and rooms in public universities. Dealing with these irritants was very frustrating for private sector industry people who were used to "getting on with things" efficiently. A private sector manager described his frustration as follows:

"The linkage does not exist. While the public universities are the best, they are very difficult to link up with. They set a lot of limits. They have created foundations to be like intermediaries, but they really don't get on well with the companies. What we would really like to have is research on what the rules are in the university and to document them and give to the companies. If we ask CENAT (the University governing body) *to do that, it will take years before anything is done".*

Another manager echoed similar thoughts:

"I can think of many projects but what are the rules of engagement and also who would I pay and what will happen with the intellectual property".

The university policy of "theoretical work takes precedence over applied" also contributes to widening the divide between the university and private sector, and as a result no effective interface exists for firms to approach universities to deal with their research inquiries. A senior staff member from a public university explained the problem as follows:

"There is a lack of culture in research and development, because both the academic programs and also the professors do not promote the culture. We cannot change anything until the culture is changed. We have to also make research more applied and work more closely with the software firms".

Another senior staff member described the problem in similar terms:

"The factors which do not help to create a union between firms and universities are: no culture or conscience to spend money on research; no incentive from government to industry to support research; the universities have limited budgets that limits research; our buildings, laboratories, equipments are all obsolete; there is a lack of maturity in professors to learn and do research. We do not have a critical mass of researchers".

There was no culture in the computer science departments to write grant proposals leading their faculty to be trapped in a "vicious circle" of no research funds leading to additional teaching loads and consequently even fewer opportunities to write grants. As a consequence, there existed no research centres around computer science in universities. Public universities, as is the case in many developing countries, are poorly resourced and provided with little incentive to do research. Poorly paid staff preferred to do consultancy rather than research work. While efforts like internships, company sponsored research etc are useful to bring about change, they are still not capable of changing the institutional conditions such as the poor salary of staff, lack of time allocated to research and the division between research and teaching staff in departments. A senior staff member in a public university lamented about this problem:

"The problem is that historically the public universities have very little resources, and because of that we cannot do research. We are doing our best, but that is not good enough to do quality research. So, what we need is more

budget to hire more people, and more incentives for doing research. Right now most professors will prefer to go to the university rather than do research because of problems of money"

Poor English Language Capabilities

English language capabilities are a vital resource for software people working on global projects, especially given the primary market focus is the USA. This skill was currently seen to be deficient by many respondents, including this senior manager of a private sector firm:

"We must improve our English proficiency. It is good now, but it should be better. We should speak like a US citizen".

While English capability was not seen as a universal problem in Costa Rica, the problem was pronounced among technical staff. This was an opinion echoed both by the industry:

"You find good people with technical skills, but if bilingual, that's where we find bad people. If we look for 10 English speaking software engineers, we cannot find them".

and also the university staff:

"In computer science, students can read English because they read a lot of technical things in English. But they are not able to speak or to even write".

While it is possible to have large-scale programs to develop English language capabilities, paradoxically a bilingual work force would make the already relatively expensive people costs in Costa Rica even more costly. The average cost of a programmer in Costa Rica is significantly higher than in India.

Inadequate Management Capabilities

Another challenge with the existing educational system in Costa Rica was that people with technical skills often have limited management skills. There are no institutionalized programs, especially for practicing executives, to come for refresher courses to the universities and develop management capabilities. The lack of these management skills was seen as a crucial constraint to marketing products, operating in the global marketplace and for making financial decisions. In short, the workforce had limited "middle management" capabilities, a point emphasized in the quotes by two industry staff:

"We are very weak in marketing skills, we have good technical people but they have no idea about the kind of questions that are asked when we go to sell the product".

"I realized that software companies have good technicians but they don't know about marketing, managing or about intellectual property. So, a lot of companies were suffocated because they began with someone paying for a program, but there was no one to manage and so they were stuck".

Some attempts were being made by the government and private sector to try and address this challenge of developing management capabilities. PROCOMER, the national software export promotion council had put in place schemes designed to improve competencies in small and medium companies to conduct software exports. A private university "ULATINA" had designed curriculum improvement in collaboration with the Inter American Development Bank funded "Prosoftware" programme and identified gaps in the existing university programs especially at the middle management level. CENFOTEC, another private institution established through private sector venture capital, was trying to bridge the gap between industry needs and pace of university change by designing courses for practicing software staff for management skills. Another initiative had been undertaken by a consulting house under a project financed by ICCI-2 (Costa Rican Initiative for International Competitiveness) to develop specific courses to increase human resource capacities related to financial and innovation issues. This same agency had also developed a year long program called "The bullet proof manager" to develop a set of 24 soft-skills. In addition, reduced fees for ISO9000 and Capability Maturity Model training and accreditation had been introduced. However, efforts by the government to introduce schemes for developing human resource capacities were suffering because of poor dissemination of information amongst the industry about these schemes and lack of take up. For example, one manager in a small firm told us that he unaware of government's schemes to financially support executives wanting to take up distance education courses. Many software firms did not see the benefit of formal accreditation such as ISO.

5. DISCUSSION AND CONCLUSIONS

Table 3 (below) draws on the theoretical frame presented in section two in order to summarise the analysis of the problematic issues in Costa Rican human resources development for software exports.

Table 3 Summary Of The Empirical Analysis

Spectrum of labour	Human Resource Policy	Situation in Costa Rica
Hi Spectrum	University R&D links	Small size and resources of most firms, lack of clusters; poor IP laws and restrictive laws on use of university resources for private work. Inertia of University structure, poor salaries and resources in public universities giving little incentive to do research or links. Weak culture of applied research, lack of critical mass of interested researchers; lack of culture of grant application leading to vicious circle, lack of formal structure for links and internships.
	University private sector links	
	Joint degrees	Some isolated initiatives such as ULatina and CENFOTEC.
	Focussed incentives	ICCI-2, bullet proof manager, ISO9000, CMM but poor dissemination of information and lack of take up.
	Attracting diaspora	No specific policies but there is only a relatively small Costa Rican diaspora to attract.
	Number, quality and capacity of Computer Science programs	More important reported lack of English in graduates. Management training in finance and marketing for executives.
Lo Spectrum	Computer language training	No specific policies. Limited or no effort in addressing lack of English language capability.
	Role of private training	
	Increasing numbers of colleges and programs	No specific policies.
	Attracting graduates from non CS background	No specific policies.

In summary, with respect to human resources capability in Costa Rica, the following key points can be made:

- Costa Rica in general has a small labour pool and compared to the major competition at relatively high costs.
- The educational focus in Costa Rica is primarily on Computer Science, and information systems related management skills are generally weak.
- English speaking skills of the technical people in Costa Rica are generally weak.
- There are no technical training institutions aimed at providing software developers with technical skills in specialized areas like biotechnology and biodiversity both of which are key economic clusters in Costa Rica where linkages would be beneficial.
- Costa Rica lacks any diaspora returnees in any great numbers.
- The linkages between university and industry are fragile.

In our work with the Costa Rican planners, we have tried to facilitate the process by informing and setting up task force groups of stakeholders from the various organisations (private and public universities, software firms, policymakers). These individuals have been tasked with systematically analysing the problems identified in table 3 and making recommendations to policy makers for change. Clearly some areas of change are less difficult to implement than others. For instance, formal and informally stated beliefs about applied research and rules on use of resources in the public universities are historically institutionalised and derived from political action and other priorities. Altering these priorities and institutions may ultimately require changes in formal constitutions and job descriptions as well as informal accedence with applied research. Changing such institutionalised practices requires clear commitment and a strong sense of incentive from all concerned. On the other hand, forming new ventures aligned to the strategic direction involving joint courses such as CENFOTEC would be relatively easier to implement, although there are resource constraints. Attracting training organisations such as India's NIIT may also be a shorter term strategy.

The Costa Rica case provides insight into the particular problems faced by many DTE's in developing the software industry as a vehicle for economic growth. Specifically, the case illustrates the limits of the routes to development presented by succesful software nations. Costa Rica's size, population and institutional setting does not provide the quantity and quality of human resource to follow the Indian early growth trajectory of low spectrum, low price and high quantity. Instead, the early Costa Rican strategy efforts focussed on developing the high spectrum which presented several paradoxes and dilemmas. The country lacks focussed R&D and with no military to provide technology transfer there are problems in following Israel's trajectory. Ireland's multinational led strategy is hampered by amongst other issues a private organisation (known as "CINDE") responsible for foreign direct investment (FDI) that is not focussed on software cluster development meaning a scattergun approach to FDI undirected by government policy.

Policymakers in Costa Rica and other DTEs who desire entry to the software exports area are forced to consider the exogenous environment in terms of market trends of buyers and suppliers in different countries. With regard to the endogenous setting, the analysis shows some aspects of how the formal and informal institutions (North 1990) may enable and constrain the development of routes to growth. In democratic Costa Rica, the policymaking process is attempting to take into account and coordinate the multiple institutions and organisations involved in software exports with varying degrees of success. Further work will focus on the continuing process of software industry development which will provide further insights into software industry development in small DTEs.

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Collaboration: Unearthing Business Opportunities for a Rural Community in South Africa

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ABSTRACT

This paper reports on the planning phase preceding an unusual occasion in which researchers have been invited to work alongside the Executive Committee of a rural education organisation (SEIDET) with a view to assisting the committee to explore business opportunities. In all probability, such opportunities will have a strong Information Systems content. While the interaction between the researchers and SEIDET is by no means accidental, it is the nature of this occasion that is of particular interest. Since the occasion is yet to come (04 September, 2004), the focus of this paper is on the nuances of the preparatory process, arguing and demonstrating that on its own, the nature of the occasion is academically stimulating and valuable. Collaboration at various levels is central to all the phases of this research. Possibilities of further exploring how these collaborative processes could in future be supported through ICT use cannot be ruled out as it is ultimately the main interest of the researchers. The collaboration is interpreted using Activity Theory, which was also used in the "made-in-Africa" efforts in understanding Information Systems Development (ISD) work practices of the INDEHELA-Methods Finnish-Nigerian project.

Keywords: Action research (AI0101), Brainstorming (AF0802), Business systems planning (EF0103), Change (AA1101), Decision making processes (AC04), Facilitation (AA0902), Group decision making (AC0402), Small business (DA0201), Social support (BD0201), Strategic planning (AF0401.01)

Introduction

Background

The Siyabuswa Educational Improvement and Development Trust (SEIDET) is a rural community-based project, which has been successfully sustained for more than ten years. It was born out of a need identified by the rural community in South Africa, for more black learners to pass Science and Mathematics up to matriculation level. Under the leadership of a community member, the initiative immediately generated significant interest and support in the community. As a result, the initiative has expanded to include programmes offered at three centres including Saturday tuition in various subjects for school learners, science for primary school children, youth career guidance, life skills and an adult basic education and training programme.
One milestone was the establishment in 1998 of a computer laboratory for teaching computer literacy. Subsequently a LAN and Internet facilities were added. In his comments on the computer laboratory at SEIDET, Walsham (2001: 206) states:

"There is no viable alternative but to start initiatives such as the SEIDET project, with the hope that they will lead to bigger projects with a wider scope in the future."

An interesting aspect of SEIDET is the collaborative nature of its activities. One of the most significant has been the collaboration between SEIDET and the Department of Informatics at the University of Pretoria, which has benefited both parties. From an academic perspective, the trust that exists between these two entities has allowed researchers to do valuable research on the unique context and processes of SEIDET. This research has been published in various academic journals and conference proceedings (Conradie 1998; De Kock 2000; Phahlamohlaka and Friend 2003; Phahlamohlaka and Lotriet 2002; Phahlamohlaka and Lotriet 2003; Scheepers and de Villiers 1999; Siebeling 2004).

The research opportunity

During the 2004 Annual General Meeting it was decided that SEIDET has matured to a stage where it is ready to embark on some sort of profit-making business and hence to play a role in government-initiated programmes aimed at black economic empowerment and job creation. In addition, funds need to be generated that can be used to maintain the current infrastructure and allow further growth. Since no one was sure how this could be done, the Executive Committee (ExCo) was asked to develop a proposal and present it to the Board before the end of 2004. ExCo approached one of the authors for assistance.
In discussions with the other authors a number of questions were raised, such as: How can a non-profit parent successfully give birth to a profit-bearing child? What should the nature of their relationship be? What risks are involved in adding profit-making activities to a non-profit-making organisation? How should these relationships be managed?

As a result four members of the Informatics Department identified a research opportunity and agreed to facilitate a workshop during which the ExCo would explore business opportunities. From a research perspective, both the nature of the occasion and the facilitation process will receive special attention, whilst at the same time ExCo are assisted in achieving their objectives.

Over the years, researchers have facilitated several interventions at SEIDET using various facilitation techniques with varying degrees of success (Phahlamohlaka and Friend 2004). These have all been intended to enhance community-based development and have successfully attracted financial support from donors. The authors believe that the envisaged 'business opportunities' workshop is distinctly different from the previous interventions, as the objectives have changed to include both altruistic and explicitly commercial aspects. Not only does this mean that special care must be taken to protect the original cause and nature of the organisation, but that a different approach and techniques for the facilitation process are probably also required.

The possible inclusion of a profit-making entity in the SEIDET community is not entirely surprising. It might be expected intuitively, but is also predictable according to the phases of innovation proposed by Douthwaite et al. (2002: 124) where an "expansion" phase, where "...adopters want the innovation to work reliably and profitably", is identified as integral to the innovation process. Although these authors applied their model to technological innovation in agriculture, they suggest that it can probably be applied equally well to "...participatory research in general" (Douthwaite et al. 2002: 128).

During research regarding the reasons for the successes of SEIDET, Siebeling (2004: 85) reported uncertainty about the expansion phase. Whilst this may have been the case at the time of that research, evidence of the expansion phase has now clearly surfaced. Siebeling also recognised that when expansion happens, it needs to be treated with caution, as "...the volunteering nature of the project could well be lost" (Siebeling 2004: 85).
Two criticisms are often leveled at research into collaboration: Firstly, that the teams and the tasks are manufactured for the purpose of the research and that secondly, students are used as subjects.

"... the use of existing teams faced with significant tasks would be critical in obtaining results that may generalize to typical work settings." (Easley, Devaraj and Crant 2003).
This research will be significant as it is situated within an entirely authentic context and will study the way a team who have been working together for a considerable period collaborate on a project that they consider important.

Links with Information Systems

There are various links between this research project and Information Systems (IS). In the first instance, the academic participants are all IS researchers. Thus their research ideas and inspiration are grounded within IS – in this specific instance the work done by Mursu et al. (2003), which advocates an Activity Theory framework as being suitable within an African IS environment. SEIDET is such an environment, and even though this specific exercise focuses on a business strategy and precedes any IS considerations per se, we expect that valuable lessons will be learnt using the Activity Theory framework. These insights will be valuable subsequently when used in an 'IS-in-Africa' context where the IS component is more obvious.
Secondly, a major research focus area of the researchers is Computer-Supported Collaborative Work, and hence earlier work connects very well with this research. Through the improved understanding of the nature of

collaboration that we expect to gain, a better understanding should also emerge as to ways in which technology may support collaboration within the African context. It is already apparent that there is a pronounced need for technology, such as Decision Support Tools, which can be used to create collaborative environments (Phahlamohlaka 2004).

Thirdly, some of the researchers have had a long collaboration with SEIDET prior to this research project, and therefore this current collaboration should not be seen as separate from that larger and longer collaborative effort. Since the previous collaborative projects have focused predominantly on ICT related issues – examples are the recent work by Phahlamohlaka and Lotriet (2002; 2003) – an interesting secondary purpose of the study will be to assess the extent to which the previous, technology-rich interactions between the researchers and the SEIDET community influence the business ideas presented by the community.

Fourthly, even though the planned workshop has little in common with ISD, a possibility exists that the actions following this interaction will be strongly linked in one way or another to the field of ISD. An example could be IS and/or IT consulting. Such opportunities may have primarily commercial aims, but undoubtedly open up exciting ISD research opportunities. The workshop must therefore be seen in its larger context of what preceded it and what is expected to happen after the event.

Levels of collaboration

Three levels of collaboration, with different time scales, have been identified. The first is the very close, established and ongoing collaboration between the university and SEIDET. The second is the medium-term collaboration between the members of the researcher team and the last is the short-term collaboration during the workshop. These have different, although compatible, goals and influence one another significantly. For example, the outcome of the proposed workshop may well initiate future collaboration.

The collaboration between the university and the SEIDET community was introduced in Section 1.1. The group's composition has not remained static but some participants have been involved since the start. This collaboration is expected to continue and may even be strengthened and can be seen as an underlying and continuous level, which provides a historical context and well-established relationships. Hence it contributes a particularly valuable asset, trust, which we hope will also be transferred to the new team members who have been invited to participate as researchers and facilitators. Davidson and Tay (2003), in their analysis of teams as dynamic structures whose survival is problematic, list this as an essential behaviour of successful teams.

Within this context, a second level of collaboration, between the Informatics researchers, has only recently been initiated but is expected to continue at least until after the workshop. Four members of the department who know each other reasonably well as colleagues planned the workshop and are doing research on the process. Two of them have worked together on the SEIDET project for almost four years. The other two are new to the project.

The third level of collaboration will take place during the workshop and is expected to be a brief, intensive period of collaboration between the SEIDET ExCo members with the researchers as trusted facilitators. Decisions reached here may give rise to new joint projects to seize the business opportunities with most potential.

These levels are not separate but nested, with the long-term collaboration encompassing the shorter-term work. Information, such as the brief identified at the SEIDET community AGM, has been passed on through each level of collaboration to the workshop. Research questions and a workshop facilitation plan were compiled by the research team and fed into the workshop. Decisions reached during the workshop were fed back to the SEIDET community. In addition, trust has been inherited by the newer groups from the most established groups. Hence there is significant communication between the different groups.

Research Objectives

There are three sets of research questions:
- In what way would collaborative practices, placed within an Activity Theory framework, facilitate a rich understanding of the interaction between researchers and SEIDET in reaching the objectives of both parties?
- How does one facilitate a workshop to change the thinking of a community-based organisation with primarily non-profit objectives to one with profit-making objectives yet still preserving the original altruistic causes?

• How do the original perceptions and expectations of the participants regarding business opportunities affect the facilitation process and outcomes during this workshop? In particular, how do these initial views affect the participants' eventual evaluation of the collaboration process and final decisions reached?

LITERATURE SURVEY

Activity Theory and its relevance to our study

The "made-in-Africa" efforts in understanding Information Systems Development (ISD) work practices of the INDEHELA-Methods Finnish-Nigerian project (Mursu et al. 2003) caught our attention while we were formulating a response to the unique occasion and research opportunity described earlier. There were two main reasons. Firstly, we are scholars from the African continent, who in interaction with international colleagues, are often challenged to give "African perspectives" to academic discourses and debates. Secondly, we have already accepted Sahay and Walsham's (1995) challenge to developing countries' Information Systems scholars to actively engage in the process of theory building. The starting point and strength in this process lies in recognizing the work of other scholars, particularly since there are so few academics active in IS in Africa and we do not want undue fragmentation. We therefore saw an opportunity to contribute towards a "made-in-Africa" tradition in order to aid in the refinement and testing of models and frameworks based on the INDEHELA-Methods (Mursu et al. 2003).

These authors base their understanding on Activity Theory. Amongst the literature that exists on Activity Theory, we found the description by Martin Ryder very helpful for our purposes (http://carbon.cudenver.edu/~mryder/iscrat_99.html):

In its simplest terms, an *activity* is defined as the engagement of a subject toward a certain goal or objective. Ryder indicates that, while in nature an activity is typically unmediated, in most human contexts activities are mediated through the use of culturally established instruments, including language, artefacts, and established procedures. He uses an example of picking and eating wild mushrooms, demonstrating that without some form of mediation, such as the advice of an experienced mushroom forager, the activity may be fatal. It is necessary to bring prior experience into the current activity. Humans have the vicarious worlds of other humans that they can invoke through the use of language and artefacts.

An activity is undertaken by a human agent (subject) who is motivated toward the solution of a problem or purpose (object), and is mediated using tools (artefacts) in collaboration with others (community). The structure of the activity is constrained by cultural factors including conventions (rules) and social strata (division of labour). Engeström (cited by Ryder) notes the role of the community as a mediator and that of social structures including the division of labour and established procedures. The knowledge that is necessary in an activity system can emerge in any one or a combination of instruments, artefacts and mediation roles.

Using this description and considering Figure 1 (adapted from Mursu 2003: 323), we are confident that Activity Theory can be used to formulate our response to the occasion. The planned workshop is an *activity*, and workshop facilitators play mediation roles. In addition, various participants are involved in activities before the workshop itself, for example, the planning process, the mediating role of ExCo between SEIDET and researchers, etc. Following Mursu's description we are engaged in a system or *network of activities*, each encapsulated by a collaborative process that could briefly be described as follows with reference to Figure 1:
Mode of operation: Collaborative (amongst researchers, amongst ExCo, amongst ExCo and researchers). These various levels were described earlier.

Collective actor (Researchers and ExCo): The collective actor transforms a shared *object* of work (collaborate to unearth suitable business opportunities for SEIDET) into a joint *outcome* (for the researchers this includes a rich understanding of the nature of interactions and processes followed and for ExCo an understanding of how these opportunities relate to SEIDET).

The actors influence the transformation process through material and nonmaterial *means of work* (facilitation, methods, techniques, IT skills and knowledge). The actions of the individual actors, which do not necessarily take place simultaneously and in the same place, are linked by *means of coordination and communication* (division of labour, rules, standards, meetings, project plan, and documentation).

In citing examples of the use of theory in interpretive research, Walsham (1995) indicated that theory may be relevant in different ways at different stages of the research process – these include theory serving as an initial guide when structuring the research, as a basis for the actual data collection and analysis or as a research end product. In our case, Activity Theory has been useful in assisting us to conceptualize the collaboration between academics and SEIDET, but we have not yet drawn on it for further research planning. (This does not exclude its use in further analysis after the event has taken place).

Related to the levels of collaboration discussed in section 1.4 is the general literature on collaboration that follows. Our goal is to examine the levels of collaboration, together with the aspects raised in the general literature on collaboration, through the lens of Activity Theory. We expect to be able to explain most if not all the collaborative processes, including those that will take place during the workshop, in terms of Activity Theory.

3.2 Collaboration

Since the researchers were asked to facilitate a workshop during which the participants want to "think together", select the most promising ideas and possibly start planning a new initiative, it is essential to identify factors that will improve the chances of success at the workshop. However, the literature survey has not revealed one overarching theory on collaboration and research reports indicate a certain amount of disagreement and conflicting results regarding success factors. Hence, the process of collaboration and factors that contribute to success will be described briefly, as these had to be considered while planning and subsequently evaluating the outcomes of the workshop. Both the *means for coordination and communication* (which are important success factors for collaboration) and the *work process* are reflected in Activity Theory.

Collaboration is a conversational, relatively unstructured, iterative, but active process during which participants work together to reach a decision, or achieve a goal (Moran 2000; Strijbos, Martens and Jochems 2004). "Collaborators engage in sharing, proposing, discussing, ratifying, and disseminating to create and maintain a 'common ground'..." (Moran 2000).
Collaboration requires consensus, mutual understanding, reciprocity and trust (Skyrme 1998). The collaborators are interdependent, and should take joint responsibility for and jointly own the results of the collaboration (Strijbos, Martens and Jochems 2004). Some authors say that collaborators should have different and complementary skills or knowledge (Moran 2000). However, even in close collaboration, team members may complete some tasks independently (Brna 2002). Olson and co-authors have found that in collocated collaborative groups, about 40% of the time is spent in discussion, about 30% in reviewing progress and 20% in coordination (Olson et al. 1992).
There is an element of learning in any collaboration, even if this is not its acknowledged, primary purpose. Collaboration, shared or jointly constructed meaning, and knowledge construction, go hand in hand.

The cooperative learning model created by Johnson, Johnson and Smith contains five elements: positive interdependence, face-to-face promotive interaction, individual accountability, social skills and group process (Johnson, Johnson and Smith 1991 quoted by Fellers 1996). The authors believe that these five elements apply equally to other forms of collaborative work.

Brainstorming

Brainstorming is a specific form of collaboration when creative thinking is emphasised and ideas are explored. Brain-storming tools are one of many different types of group support systems that may be selected by groups reasoning towards a goal (Briggs, De Vreede and Nunamaker 2003). However, brainstorming differs from general collaboration in some important ways. It is more likely to result in decisions being made than in a concrete deliverable. Ideally, the brainstorming process generates synergy, a wealth of ideas and the freedom to express them. Brainstorming is the aspect of collaboration that will be focussed on most during the workshop that is being planned.

Team cohesion

This has been selected for attention because the groups participating in this research have good relationships and we are particularly interested in investigating how this affects collaboration during the workshop.

Definitions of collaboration emphasise the need to communicate and achieve mutual understanding (Easley, Devaraj and Crant 2003; Sole and Applegate 2000). Communication is facilitated when a common vocabulary, shared knowledge and compatible values exist.

"These associated meanings are learned over time... In addition, since community members themselves gradually take this knowledge for granted, they cannot readily isolate it nor easily articulate it to colleagues from other communities" (Sole and Applegate 2000).

Yet another significantly factor affecting the perception of success in collaboration is the extent to which the individual's interests coincide with the decisions made by the group (Reinig 2003). The more homogeneous the group is, the more we can expect individual interests to be similar or at least compatible.
On the other hand, diversity, in terms of skills and in terms of innate qualities such as brain profile, is identified as being useful in collaboration in general but particularly during brainstorming (Briggs, De Vreede and Nunamaker 2003). In fact it has even been suggested that, "... shared norms may facilitate regular forms of co-operation, but may simultaneously block new innovations." (Froestad 2001). A balanced contribution of ideas and a perception that team members contribute equally and support each other also contribute to both the outcomes and satisfaction (Easley, Devaraj and Crant 2003). These occur most often when there is a strong, existing relationship and group cohesion. This relates to research which suggests that team size may influence team performance. Research has shown a positive relationship between team size and idea generation.
Thus this research will note whether the views of collaborators are similar regarding the strengths, weaknesses, opportunities and threats facing the new venture and what affect variety has on the perceived success of the workshop.

Collaboration as a process

The next aspect that will receive attention is the collaboration process itself. This has been selected as the workshop facilitation must assist this process. Briggs, De Vreede and Nunamaker (2003) identified five basic patterns of thinking that are required to move through a reasoning process, namely, Diverge, Converge, Organize, Evaluate, and Build Consensus. Divergence predominates during the brainstorming phase but a second phase, during which decisions and plans have to be made, will subsequently be needed and the other thinking patterns will be required.
Massey, Montoya-Weiss and Hung (2003) have a collaboration process model, which is compatible with the patterns of thinking. They describe four processes: informational, decisional, interpersonal and process management. At times collaborators simply need to convey ideas and information and there is no need for critical discussion. However subsequently these ideas should be discussed, criticized, evaluated, understanding needs to be confirmed, and the shared ideas may be developed further. This leads to decisions being made. Two further processes support these two thought processes. Interpersonal behaviors support the team functions and process management is required to plan the collaboration, guide the discussion while it is in progress, ensure that decisions are correctly recorded and control the process (Massey, Montoya-Weiss and Hung 2003). The more complex the collaboration, the more important it is that all four processes are given sufficient time. However time can be saved if the team already know each other well and if process management has been planned ahead of time and is managed by a facilitator.

RESEARCH DESIGN AND METHODS

The research has been designed to promote a rich understanding of the social issues involved in collaborative practices between the researchers and SEIDET (refer to Figure 2).
The planned interaction holds benefits for all the participants. The researchers will benefit from the lessons learnt, while SEIDET as an organization will benefit from the researchers' inputs and facilitation. The research design has significant reflective components. These include the decision process which will allow ExCo to proceed with an appropriate commercialization process of SEIDET, hopefully without destroying the non-commercial attributes that have sustained it over the years. The researchers reflected on the nature of the collaboration at various levels, including their own collaboration, during ten meetings as they searched for a shared understanding regarding what was required at each level and during the actual workshop.
The research design also has an action component – the planned use of a combination of Strategic Development Planning (White et al. 1996: 38) and Nominal Group Technique (Delbecq 1975) to facilitate interaction and

collaboration during the workshop. The researchers will use Repertory Grid (Hunter and Beck 2000) after the workshop to structure their analysis. The researchers and the SEIDET ExCo have their own agendas regarding what needs to be achieved during the workshop. The researchers intend to probe ExCo if certain expectations (e.g. preferred forms of business possibilities, balance between commercial and non-commercial interests etc.) do not emerge during the discussions. The combination of facilitation techniques will lead to a mix of structured and unstructured sessions.

The action, interaction and reflection elements indicate that this is an action research intervention. Although action research implies a number of cycles and there is no mention at this stage of further research cycles, this research interaction has to be viewed within the perspective of larger collaborative practices between SEIDET and the research community at the university, and in particular, the work reported on by Phahlamohlaka and Lotriet (2003). Activity Theory is the lens through which the entire interaction process is examined.

The nature of the research and the research questions also indicate the critical and interpretive domains. Data gathered will include images and field notes that will allow for interpretive and critical assessment of the event. From the perspectives of ExCo, the workshop will be successful if the meeting identifies practical and feasible business opportunities for them to take back to the Board and the community for further discussion. The researchers will consider it to be successful if the process allowed the participants to put forward their proposals and concerns freely; if these proposals are indeed focused on business opportunities whilst keeping the original cause intact and if the suggestions are treated with the required seriousness and respect.

The actual process will include creativity-enhancing features so that diverse ideas are encouraged (Briggs et al. 2002). However during the convergence and consensus forming phases of the workshop we plan to capitalise on the strength of the relationships and communication.

EXPECTED RESULTS

The researchers expect a good fit between the Activity Theory framework proposed by Mursu et al. (2003) and the activities of the workshop. Firstly, the framework and the nature of the research are based on similar approaches. Secondly, the framework contains most of the elements that are needed to provide a coherent description of the planned processes and activities. The framework is useful as collaboration in itself does not have a unified theory. Finally, the framework was developed for use in Africa in the 21st century. Activities at SEIDET, including the collaborative project described in this paper, are firmly rooted within the African developmental context. Lessons learned may extend Activity Theory and its application within the IS-in-Africa context. Finally, the framework has a systems orientation. This will be helpful because the workshop will constitute a system of actions between the researchers and the SEIDET community that is intended to satisfy the various goals that have been set.
The facilitation techniques and procedures have been chosen to create an environment in which ExCo are encouraged to identify business opportunities. The skills and experience of the researchers will supplement those of ExCo and hence will ensure they address business issues and concerns that they have not identified themselves. Two different traditions of collaboration will meet during the workshop, namely the African social tradition of 'ubuntu' and the formal techniques commonly practiced in the business world. New collaboration techniques can be developed in our multi-cultural country by exploring the way these work together.

The workshop participants' preconceived ideas can influence the process of collaboration and the outcomes of the workshop in a number of ways. It is possible that, because they have worked together closely at SEIDET for a long time, all the participants will have similar ideas and that they will find it difficult to critically evaluate established truisms. An example of this might be the perceived value of Information Technology or the ease and potential profitability of starting a 'dot com'. This could result in little creativity, self-fulfilling prophesies and, although the participants might believe that both the process of collaboration and the outcomes were very satisfactory, the actual value might be low. Should this occur the researchers will intervene in order to challenge and expand these ideas. However, it is equally possible that the established relationships will permit an open and candid discussion that would be very fruitful and would be affected negatively by artificial challenges by the researchers. Having identified these contrasting possibilities, the plan for the facilitation process requires the researchers to be sensitive to the appropriate times and forms of intervention.

Systems analysts are frequently required to collaborate with end users and they often fill the role of facilitator. Hence it is useful for IS lecturers to practice the theory of collaboration and develop their skills while critically observing the process and assessing the effectiveness of various techniques. This is, therefore one of the ways

this project is expected to contribute to Human Resource Development. The second is via the expansion of ExCo of SEIDET's horizons by exploring business options.
In this particular case we were keen to explore how an African version of Activity Theory could be combined with collaboration amongst a diverse group of collaborators. Ultimately, this might lead to advice regarding ways of supporting collaboration in Africa using IT.

CONCLUSION

Planning an event that is intended to produce practical results has already resulted in a rich research opportunity. Several valuable points have already been noted.
Firstly, a link between Activity Theory and various aspects of collaboration has been identified providing a way of looking at these aspects through a new theoretical lens. This is significant, since there is no unifying theory on collaborative practices and hence it may also be helpful to use Activity Theory to look at Computer Supported Collaborative Work and related areas such as Group Support Systems and Virtual Team collaboration.
Secondly, IS research is said to be a 'fragmented adhocracy' (Banville and Landry 1989), where independent researchers tend to pursue independent lines of research. We are striving to counter this by building on the work of the INDEHELA team (Mursu, Soriyan and Korpela 2003). The primary reason for doing so is to avoid automatically accepting IS models from developed countries and instead to seek an African orientation to IS research.
Thirdly, while reflecting on the planning process for the workshop, it became clear that the researchers cannot facilitate the workshop from an impartial position. Rather, they have to be involved actors who probe and participate.
Lastly, the importance of collaboration between industry (in this case the community) and academia cannot be over emphasised. The unique advantage that this specific occasion has afforded the researchers resulted from the decision by SEIDET to bring the researchers on board at a very early stage of the process. This allowed the researchers sufficient time to prepare a theoretical base for their inputs and actions.
This paper reports on planning that was done ahead of the workshop, and there was no intention to use IT to support the group decision-making process. Hence, the research concentrates on collaboration rather than information systems. However, as a postscript, we can report that although during the workshop not all the business ideas raised involved ICT, the process of establishing a business venture has proceeded surprisingly quickly and it seems that it will have a strong ICT component.

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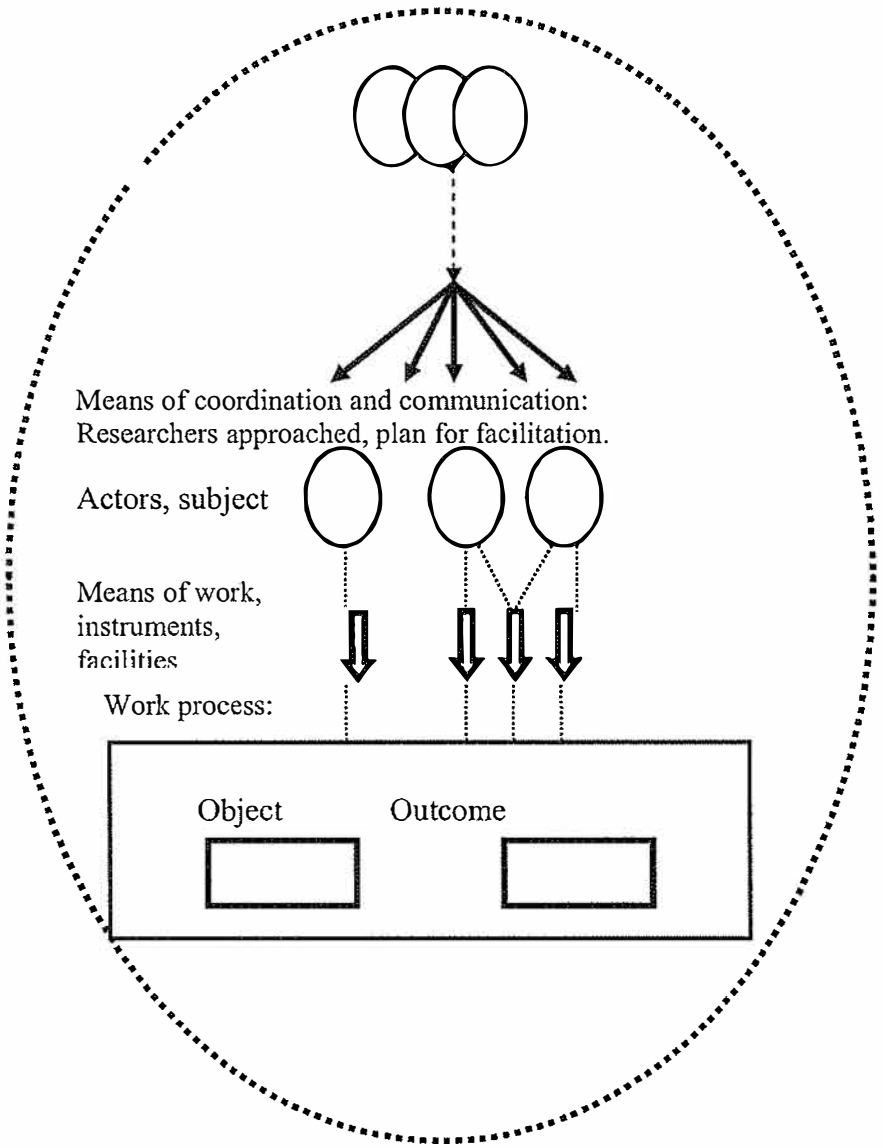

Figure 1: The elements of a collective work activity or network of activities (Mursu 2003: 324, adapted from Korpela et al. 2000a)

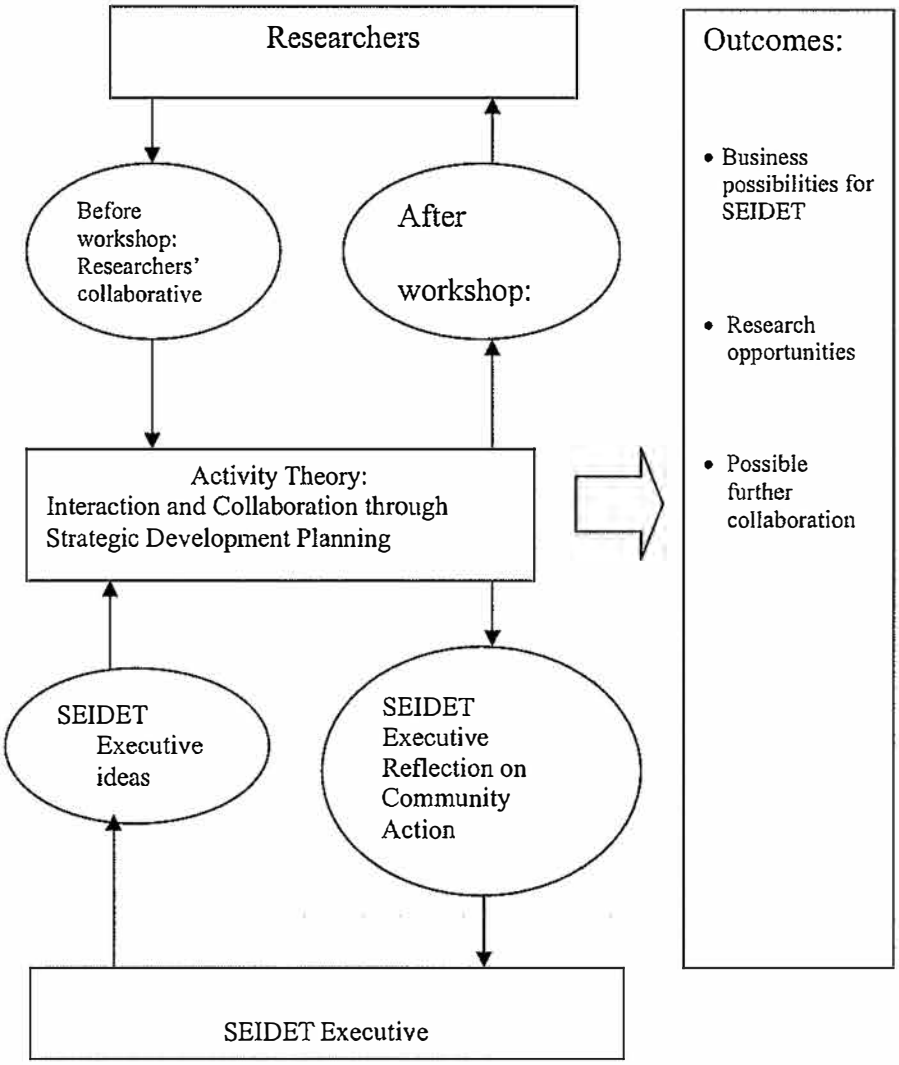

Figure 2: Research Design

SESSION C2: RESEARCH-IN-PROGRESS PAPERS

Expert Assessments of E-Business in Developing Countries: A Theoretical Model of National Infrastructure

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ABSTRACT

This study investigates experts' assessments of the pertinent factors affecting e-business in developing countries from a national infrastructure perspective. We design and conduct a survey that empirically solicits information from experts in e-business in Sub-Saharan Africa (SSA) in the first phase (completed and reported here), and in Latin America in the second phase (currently in progress). Our initial results for SSA using PLS analysis show that experts believe that non-specific general information and communication technology (ICT) policies are not very influential, while policies targeted specifically towards e-business are important in affecting e-business capabilities and in obtaining value from e-business, as well as ICT infrastructure. ICT infrastructure only affects e-business capabilities, but not its value. Experts believe that national governance institutions positively affect e-business value, but not capabilities. They do not believe that commercial infrastructure significantly affects e-business outcomes. This study theoretically and empirically distinguishes between two different dimensions of e-business outcomes: specific capabilities and value derived from e-business. It operationalizes the effects of national governance institutions and commercial infrastructure on e-business outcomes and empirically tests for their effects. The study provides empirical support for conceptual arguments for the need of ICT policies specific to the needs of e-business. It is the first study that conducts a quantitative, broad-based survey on factors that contribute toward e-business in the Sub-Saharan Africa and Latin America regions.

INTRODUCTION

In many cases e-business would be [the] first choice for SMEs, but the infrastructure does not exist to support it—even where ICTs are available, there may not be power, education, payment systems, markets or water, and these are all essential ingredients for the "business" part of "e-business".

Respondent to e-business survey in Sub-Saharan Africa

The Secretary General of the United Nations has argued for the paramount importance of electronic business diffusion as a major impetus for socioeconomic development in developing countries(UNCTAD 2002). There has been a wealth of information systems research that has studied information technology in developing countries (El Sherif and El Sawy 1988; Jarvenpaa and Leidner 1998). A particularly notable stream of research has been an extended study of the effects of policy and culture on information technology (IT) in Arab nations (Straub 2001).

E-business—business transactions or processes using the Internet—is just one dimension of the benefits that the Internet can bring to developing countries. However, e-business stands out in that it generates income from economic activities for citizens of a developing country who are engaged in commercial enterprise. Moreover, it provides employment and generates government revenues in taxes. Thus, e-business has the potential to be self-propagating and self-sustaining, the holy grail of development researchers and organizations on their quest for sustainable development. By fostering internal and external trade, e-business might create and attract wealth that could be used to develop structural infrastructure such as roads, telecommunication networks, and dams; and social infrastructure such as hospitals and schools. Hence, focusing on the commercial applications of the Internet in developing countries is a valuable perspective, since such applications potentially would have significant beneficial effects on all other applications of the Internet, such as telemedicine, online education, and electronic government.

In the opening quotation of this paper, the United Nations Secretary-General directly linked e-business with economic development, a national-level construct. Indeed, the most fundamental motivation for this study is identifying e-business as a means for increasing economic development in developing countries. Most development research and studies of ICT diffusion in the information systems literature operate on this level (Montealegre 1999; Straub, Loch and Hill 2001). Based on the importance of e-business on developing national infrastructure and the quality of life in the world's poorer countries, we are conducting this present study as part of a larger study that investigates the pertinent general factors affecting e-business in developing countries. In this particular study, based on the theoretical importance of national infrastructure in e-business adoption and transfer, this study focuses on answering the question:

What kinds of national infrastructure contribute towards effective e-business outcomes in developing countries?

Theoretical background

Information systems research has produced many frameworks that examine different dimensions of factors necessary for supporting e-business (for a comprehensive review, see Ngai and Wat 2002). This research covers e-business applications, technological issues, support and implementation, and many other aspects. In addition, theories on technology and innovation transfer, adoption, and diffusion have emerged that are helpful in understanding how ICTs can spread in a country (Fichman 2000). There has also been an increasing amount of literature on the factors that affect development of the Internet and e-business in developing countries (Dutta 1997; Mbarika 2001; Montealegre 1999; Travica 2002; Wolcott, Press, McHenry, Goodman and Foster 2001). The Arab Policy and IT (APIT) project, based on a research model of information technology transfer, has spawned a large stream of research that investigates various aspects of ICT outcomes in developing countries in general, and in Arab nations in particular (Straub 2001). In this model, among other hypotheses, National ICT Policies positively influence ITT/ICT Outcomes.

There have been mixed results about the similarities and differences in Internet and e-business diffusion between developing countries and developed countries. There is a strong need to understand the contextual settings of the developing countries being studied in order to effectively apply Internet and e-business technologies—developed in the West—to these countries. We borrow from this theory base to develop an infrastructure model for e-business in developing countries. We discuss the constructs that lead to this model in the sections that follow.

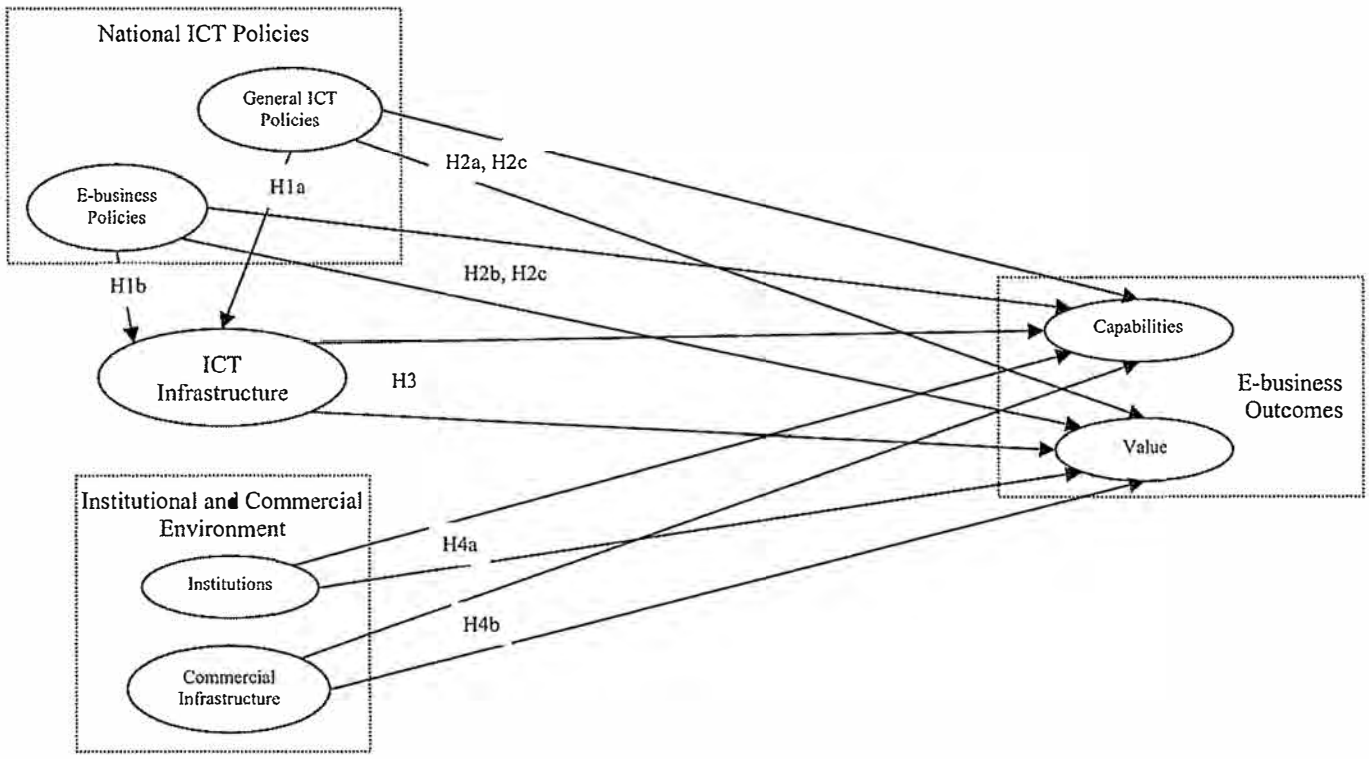

Figure 1. National infrastructure model of e-business outcomes

National Infrastructural Model of E-Business Outcomes

The model we propose here has three predictor constructs that we postulate directly affect e-business outcomes on the national level. **ICT Policies** has two dimensions: ***General ICT Policies*** and ***E-business Policies***. We propose that **ICT Infrastructure** is unidimensional, whereas the **Institutional and Commercial Environment** has two dimensions: ***Institutions*** and ***Commerce***. In addition to their direct effect on E-business Outcomes, we postulate that both ICT Policies dimensions have a direct effect on ICT Infrastructure. Figure 1 displays the national-level model with all the postulated paths labeled with the specific hypotheses we offer in the following sections.

E-Business Outcomes as the dependent variable: Capabilities and Value

From the literature review, we observed that there are two general aspects to evaluating e-business, particularly from an empirical perspective. First, many studies examine the actual applications and functionality that e-business enables; that is, they emphasize the **Capabilities** that e-business enables, such as providing product information, interactive websites, online transactions, etc (Kardaras and Karakostas 2001; Zhu and Kraemer 2002). One of the challenges in harnessing the potential of e-business has involved understanding how best to measure it in order to maximize its benefits. A second aspect of evaluating e-business involves assessing if it delivers its promised benefits; that is, if it provides **Value** to the businesses that employ it. Value, or the success of e-business, can be measured from many different perspectives. It can be evaluated in terms of increases in sales, profits, or customers. It can be seen from the perspectives of saving costs, increasing process efficiency, saving time, reducing personnel requirements, and so on.

Although E-Business Capabilities and E-Business Value are closely related, we believe they are distinct enough that a factor might have different effects on these two dimensions of E-business Outcomes. For all the constructs in our models, we postulate their effects on each of these two dimensions of E-business Outcomes. Although we have pointed out that the effects might be different on the capabilities and value dimensions of e-business, we hypothesize in every case that they will be in the same direction; that is, either both positive or both negative. One of the contributions of this study is to explicitly make this distinction in a single theoretical model.

ICT Policies

General ICT Policies

Various studies have examined the effects of ICT policy on the development of ICT infrastructure. King et al (1994) frame ICT policies in terms of how national institutions either influence or regulate the demand or supply of ICTs and technology innovation. They argue that these institutional effects occur through acts of knowledge building, knowledge deployment, subsidies, mobilization, standard setting, and innovation directives. Montealegre (1999) found that ICT policies were significant in ICT development in four Latin American countries, and Raman and Yap (1996) found the same to be true in Malaysia. Numerous other studies have also confirmed their effects. From the literature we examined, we offer the following hypotheses:

Hypothesis 1a: National policies that favor the development of ICTs in general will increase the level of ICT infrastructure in developing countries.

Hypothesis 2a: National policies that favor the development of ICTs in general will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

E-Business Policies

A few studies have examined the effects of ICT policy that focuses on issues peculiar to e-business, such as those concerning digital signatures and intellectual property rights for digital products. Jarvenpaa and Tiller (1999) call on managers to align their e-business strategies with the policy environments in which they find themselves, as such strategic alignment is critical for effective e-business outcomes. Checchi et al (2002) found that the Egyptian government has implemented a few policies specifically focused on e-business, including encouraging e-commerce activity within the government itself, and supporting the e-business legal framework. These and other studies indicate that such targeted policy is necessary for effective e-business outcomes, over and above the effects of more general ICT policy. Thus, we also hypothesize:

Hypothesis 1b: National policies specifically tailored to promote e-business will increase the level of ICT infrastructure in developing countries.

Hypothesis 2b: National policies specifically tailored to promote e-business will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

Hypothesis 2c: National policies specifically tailored to promote e-business will (i) increase capabilities more and (ii) yield more valuable e-business outcomes than will general ICT policies in developing countries.

ICT Infrastructure

To enable the use of the Internet, developing countries need solid telecommunications infrastructures. There has been a considerable amount of research arguing that ICT infrastructure is a necessary prerequisite for effective e-business outcomes (Kardaras and Karakostas 2001; Mbarika and Byrd 2003) . Other research has argued more generally about the effects of ICT infrastructure on economic development (Dutta 1997; Odedra-Straub 1993; Raman and Yap 1996), but we could argue, in the context of this present study, that this relationship is at least partially mediated by e-business outcomes. Based on this body of research, we hypothesize:

Hypothesis 3: Higher quality ICT infrastructure will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

Institutional and Commercial Environment

Institutional theories are helpful in understanding how the Internet and e-business might become successful in developing countries. In this study, we identify two kinds of institutions that operate at the national level, and that would affect e-business outcomes in Sub-Saharan Africa: Governance Institutions and Commercial Infrastructure. **Governance Institutions** refer to the effectiveness of the government that lays a background for all kinds of social interactions, including business using the Internet. The **Commercial Infrastructure** refers specifically to those aspects of the institutional environment that provide support for business to go on effectively.

Governance Institutions

Some research in developmental economics has studied the factors that contribute towards economic development in developing countries (Sachs and Warner 1997). These studies measure the quality of institutions in terms of factors such as government regulation and bureaucracy, the rule of law, and corruption and graft. Although the institutional environment is recognized as an important factor in economic performance in general, as well as in the ICT literature (King et al 1994), it has not been a common factor in the e-business literature. Nonetheless, e-business, like traditional business, is set in an institutional context that might facilitate or hinder its successful operation. Although developing countries might enact far-reaching ICT and e-business policies, strong governance institutions are necessary to implement these visionary policies, otherwise they amount to little more than ineffectual politicking. Thus, we include this construct in our model, believing that high quality institutions are conducive to effective e-business. We hypothesize:

Hypothesis 4a: More functional and stable national governance institutions will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

Commercial Infrastructure

One shortcoming of many frameworks that model e-business and ICTs is that they are not specifically tailored to a developing country context. While many of the factors these studies highlight are universally applicable, developing countries face a number of unique issues that are not major factors in the developed countries in which most theories of e-business and IT diffusion are set (Bingi, Leff, Shipchandler and Rao 2000; Travica 2002). In his study of e-business diffusion in Costa Rica, Travica (2002) provides a valuable framework that captures many of these issues in dimensions that foster more careful analysis. He explicitly incorporates many important factors that the other frameworks take for granted, such as infrastructure for physical transportation of goods and consumer culture pertinent to e-business. His framework is based on six layers of infrastructure required to support e-business in a developing country: (1) Transportation for delivering physical goods and documents; (2) a reliable delivery system such as effective postal services; (3) Internet-enabling telecommunications, including both physical and legal infrastructure to facilitate the efficient operation of the Internet; (4) A functional software industry to develop and support the necessary Internet applications; (5) E-payment infrastructure, which includes a widespread and effective credit card system, as well as secure and efficient banking; and (6) A cultural layer, which refers to the various cultural aspects of consumer behavior that will incline individuals to use the Internet for commercial activity.

Developing countries are lag considerably behind developed ones in all these six dimensions. Based on this theoretical base, we hypothesize:

Hypothesis 4b: Higher quality commercial infrastructure will (i) increase the capabilities of e-business and (ii) yield valuable e-business outcomes in developing countries.

METHODOLOGY

In order to focus and obtain meaningful results, we restricted the scope of our study in a number of important ways. First, rather than looking at developing countries in general, we have chosen to focus on Latin America and Sub-Saharan Africa. These are some of the regions that have less prior research focus regarding e-business, and we believe are in greatest need of such research. Thus, we are conducting our study in two phases, each examining e-business in one of these two regions.

In order to be more focused in our responses, we restricted the scope of this study to small and medium enterprises (SMEs) in urban centers. We were interested on the effect of e-business on locally owned organizations, and we realize that e-business is insufficiently developed at this time in rural areas.

We administered the questionnaires using World Wide Web, paper, and electronic document versions, and distributed the questionnaires to respondents via World Wide Web, regular postal mail and e-mail, respectively. Guided by the theoretical understanding we obtained from our literature review, we combed the pertinent literature carefully to identify questionnaire items that are pertinent to our study of e-business in developing countries. Borrowing from and adapting items used in these studies, we developed multiple-item measures for each item (APEC 1999; Bingi et al 2000; Dutta 1997; Eze 2002; Jarvenpaa and Tiller 1999; King et al 1994; Mbarika 2001; Mbarika and Byrd 2003; Montealegre 1999; Sachs and Warner 1997; Travica 2002; Wolcott et al 2001). We pilot-tested and refined the instrument on a subset of our final sample. Details on the full instrument are available at http://chitu.okoli.org/mis/research/dissertation/dissertation.html.

Phase 1 Results: Sub-Saharan Africa

For the first phase of our study, we used two databases of experts in African ICTs. First, we obtained contacts from a database of 1,253 organizations from the African Information Society Initiative (AISI), a project sponsored since 1996 by the United Nations Economic Commission for Africa. Our second African data source was the database of experts provided by the African Research for Information Society Emergence (ARISE), a project sponsored since 2002 by the International Development Research Centre of Canada. The particular focus of this database is on "African professionals, researchers and activists concerned with the social issues involved in building the Information Society in Africa." From this list we obtained the names and e-mail addresses of 196 such experts.

We used the 896 AISI contacts left after conducting the pilot study and all the contact from the ARISE database, totaling 1,092 expert contacts. We received 158 completed responses, giving an effective response rate of 22.0%. After cleaning the data, we were left with 147 usable responses. Responses were for 29 different countries in SSA, mostly from East Africa, Southern Africa, and West Africa.

Half of the experts (50.3%) were from commercial organizations, with the rest evenly divided (15.9 to 17.2%) among nongovernmental, academic, and governmental organizations. The experts had an average of 6.7 years of experience in e-business regarding Sub-Saharan Africa. They had lived an average of 21.1 years in SSA, and 7.1 years in technologically-advanced countries outside the continent of Africa. The median and mode age group for respondents was from 35-44 years. The median and mode of highest education level attained was a master's degree. 89.0% of respondents were male.

Testing and Refining the Measurement Model

There are four steps involved in testing and refining the measurement model; that is, the part of the model that ensures that measurement variables correspond to their theoretical constructs (Chin 1998b): confirmatory factor analysis, checking for cross-loadings, reliability measures of the constructs, and discriminant validity.

Confirmatory factor analysis (CFA) ensured that, in a factor analysis of all the items in the instrument, each item loaded on the construct to which it is theoretically assigned. Next we verified that no items cross-loaded on a construct other than the one for which it is theoretically specified. Then using composite reliability (r_c) scores and the average variance extracted (AVE), we confirmed that the remaining constructs were reliable measures of their respective constructs. Finally, we tested for discriminant validity by examining the correlations between the latent factor scores of each construct in the model; we concluded that all constructs in the model were indeed distinct from each other based on testing the square roots of the AVEs.

Testing the Structural (Inner) Model and Hypotheses

We conducted PLS analysis using PLS Graph 3.0 on the national infrastructure model to test all the hypotheses. Table 3 displays R^2 for each endogenous construct. The exogenous factors explained 27.4% of the variation in E-Business Capabilities and 24.7% of E-Business Value, an average of 26.0%. General ICT and specific E-business Policies explained 13.9% of ICT Infrastructure. All R^2 values were statistically significant ($p \leq 0.001$).
Table 3 displays the coefficients for all hypothesized paths in the model with their significances (obtained by bootstrapping), and Figure 2 displays the structural path diagram with the coefficients of paths that were statistically significant at the 0.05 level.
While experts perceived e-business policies to be significantly influential on ICT infrastructure (H1b) with a path coefficient of 0.394, there was no apparent effect of general ICT policies (H1a). Similarly, experts perceived no effect of general ICT policies on either e-business capabilities or value (H2a), whereas they perceived e-business policies to be significantly influential (H2b) with path coefficients of 0.422 and 0.280, respectively. All these coefficients were meaningful by Chin's (1998a) criteria, being above 0.2. These results support our hypothesis that experts would consider e-business policy to be more important for e-business outcomes than general ICT policies (H2c).
The experts perceived that ICT infrastructure would increase the specific capabilities of e-business in SSA (path = 0.253), but did not think it would help businesses yield valuable results from e-business (H3). On the other hand, they believed that strong governance institutions (H4a) would enable e-business to produce valuable results (path = 0.340), but not specific capabilities. The effect of experts' perceptions of commercial infrastructure (H4b) on specific capabilities was not significant, nor was the effect on the value of e-business, which had a path of 0.153 and p-value of 0.159 in the infrastructural model.

Table 3. Path coefficients and R^2 for national infrastructure model

Predictor Constructs		Predicted Constructs	Path	*t*	p(*t*)
ICT Policies	→	E-biz Capabilities	-0.018	-0.198	0.843
	→	E-biz Value	0.014	0.118	0.906
	→	ICT Infrastructure	-0.035	-0.307	0.759
E-biz Policies	→	E-biz Capabilities	0.422***	4.515	0.000
	→	E-biz Value	0.280*	2.344	0.020
	→	ICT Infrastructure	0.394**	3.276	0.001
ICT Infrastructure	→	E-biz Capabilities	0.253**	2.644	0.009
	→	E-biz Value	0.094	0.929	0.354
Institutions	→	E-biz Capabilities	-0.118	-1.141	0.256
	→	E-biz Value	0.340***	3.794	0.000
Commerce	→	E-biz Capabilities	-0.037	-0.350	0.727
	→	E-biz Value	0.153	1.416	0.159

	R^2	*F*	p(*F*)
E-biz Capabilities	0.274***	13.385	0.000
E-biz Value	0.247***	11.638	0.000
ICT Infrastructure	0.139**	4.549	0.001

ICT Policies

We were surprised to find that most experts did not seem to feel that general ICT policies had any influence on e-business outcomes, and not even on ICT infrastructure in SSA. From reading the qualitative comments the experts gave, some apparently believed there was an influence, and were optimistic about governments' role, but, most experts felt that SSA governments are doing little by way of policy to further ICTs and e-business in their countries.

A number of cynical comments expressed little confidence in governments' ability to significantly influence e-business through general ICT policies, suggesting that many experts believed that even when governments might establish general ICT policies, they often do not carry out these policies. Because of this disconnection between policy enactment and follow-through, the establishment or non-establishment of ICT policies has little influence on the actual incidence of ICT infrastructure and e-business outcomes.

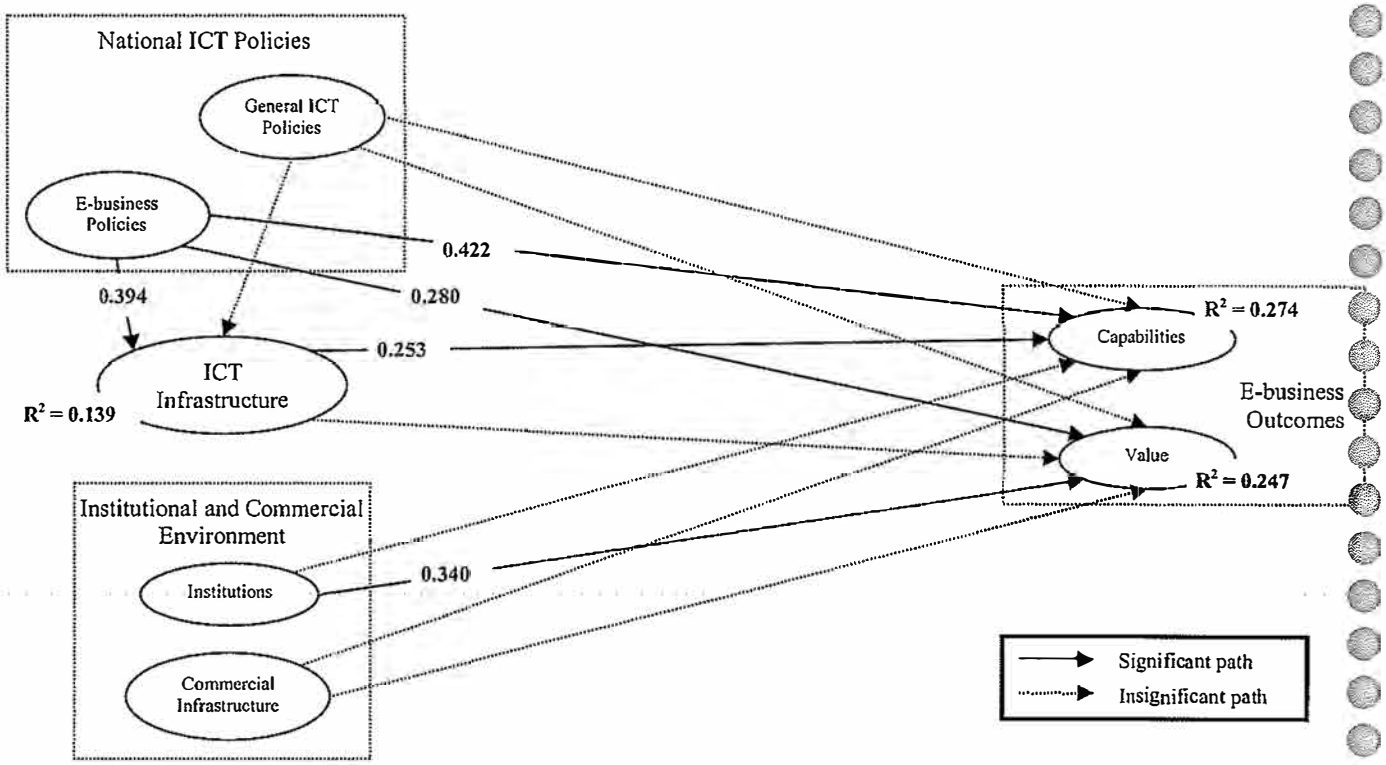

Figure 2. National infrastructure model of e-business factors with coefficients of significant paths

In contrast, the experts' strong affirmation of the effects of e-business policy confirms the sentiment of various studies that have called for ICT policies that focuses on issues peculiar to e-business, such as those concerning digital signatures and intellectual property rights for digital products (Jarvenpaa and Tiller 1999; Kardaras and Karakostas 2001).

ICT Infrastructure

The experts believed that ICT infrastructure would significantly affect e-business capabilities, but not necessarily e-business value. This finding indicated that experts distinguished between the infrastructure's ability to enable specific capabilities and the likelihood that it would give value to those SSA businesses that employed it. The literature we have found on the effects of ICT does not generally distinguish between the capabilities it enables and its value; these two dimensions are generally lumped together. However, it seems that more literature tends to consider the benefits of ICT in terms of the capabilities it would enable for its users. Thus, my findings regarding e-business capabilities were consistent with the literature.

In contrast, the experts believed that ICT infrastructure in itself does not necessarily contribute towards e-business value. This makes sense, considering that even if SSA businesses were able to set-up advanced websites with many interactive features, they might nonetheless be unable to get much value out of it for many possible reasons. For example, poor payment systems might prohibit online transactions, and low levels of trust might discourage electronic transactions.

Institutional and Commercial Environment

The initial results of testing the institutional and commercial hypotheses were as expected: Experts believed that strong, effective governance institutions would enable e-business to yield **value**. This supports our conjecture that regarding e-business value, adequate ICT infrastructure is not enough—countries need strong institutional environments. However, related to e-business **capabilities**, our result is at odds with the literature we have reviewed. We found that experts did not generally believe that governmental institutions had a statistically significant effect on e-business capabilities, in contrast to considerable literature that has argued and empirically found otherwise (King et al 1994; Montealegre 1999; Raman and Yap 1996).

Overall, it seemed that respondents took two kinds of attitudes towards the effects of strong government in their countries. First, many were hopeful that better governments would improve e-business, and believed that bad governments were largely responsible for low incidences of and prospects of e-business. Second, there was often a cynical attitude towards what impact governments could have on e-business. Many experts believed that their governments were generally insincere and ineffective. The results seem to indicate that the experts believed that an institutional environment that allows businesses to increase their e-business capabilities does not necessarily permit them to derive value from their e-business applications.

Regarding commercial infrastructure, the result surprisingly was contrary to our hypothesis, and even contradicted Travica's (2002) findings of the necessity of commercial infrastructure in Costa Rica, though his study focused on business-to-consumer e-commerce. Although SSA has similar or worse conditions, the experts did not feel that commercial infrastructure had much effect on specific e-business capabilities and applications nor on the value derived from e-business. Their comments indicated that commercial infrastructure often had little effect on e-business capabilities in SSA because poor management of infrastructures such as railways and petroleum distribution—often government-controlled in SSA countries— impedes the effectiveness of such infrastructures even when they are present

Moreover, not only did experts believe that effective commercial infrastructure did not necessarily increase the capabilities or value of e-business in SSA, but their comments indicated that many believed that a solid commercial infrastructure might actually impede the development of e-business. Many apparently felt that comfort with traditional commercial institutions would inhibit the adoption of e-business, both by businesses providing Internet services and by consumers using them. It seems that when business people in SSA are generally content with the commercial systems—or rather, are not sufficiently aware or do not sufficiently appreciate the potential of e-business—such complacency would limit the potential value of e-business.

Outline of Phase 2: Latin America

We have obtained access to a database of 382 ecommerce and ICT experts from FUNDRES, an NGO focusing on ICT issues in developing countries. The experts in this database include the same categories discussed above, as this organization collaborates with other NGOs, governments, universities, and other public and private institutions. We are currently looking for additional sources of Latin American e-businesses experts.

Using the instrument developed as a result of our pilot study, we will follow the same procedure of data collection that we used for the SSA phase of the study. We will use the World Wide Web, paper, and electronic document versions and distribute the questionnaires to respondents via e-mail.

We will repeat the four steps of testing and refining the measurement model (confirmatory factor analysis, checking for cross-loadings, reliability measures of the constructs, and discriminant validity) with the LA data, checking for possible differences from the refined instrument for the SSA tests. We will use the same PLS techniques to test the same structural model with interactions. In addition to testing LA separately, we will also test the model using all the data together.

CONCLUSION

Even from the first phase results, this study offers a number of important contributions. First, it clearly distinguishes between two different dimensions of e-business outcomes: specific capabilities and value derived from e-business. Our empirical discriminant analysis justified this distinction of dimensions, and our results with SSA have shown that this distinction is important because certain factors might affect one kind of e-business outcome in one way, and another kind in a completely different way. Second, this is the first empirical study we

are aware of that operationalizes the effects of national governance institutions and commercial infrastructure on e-business outcomes and empirically tests for their effects. Third, this study provides empirical support for studies that have argued conceptually for the need of ICT policies specific to the needs of e-business (Jarvenpaa and Tiller 1999; Kardaras and Karakostas 2001). By showing that experts believe that e-business policies have strong effects both on general ICT and on specific e-business outcomes, our study adds weight to this call for focused policies. Fourth, this is the first study that conducts a quantitative, broad-based survey on factors that contribute toward e-business in the Sub-Saharan Africa and Latin America regions. Most other studies have been either conceptual or qualitative, with limited generalizability.

The next step is to test the national infrastructure model within specific regions outside of SSA. This study will extend our research to Latin America. It will be interesting to see what the results would be in this other developing region, whose national infrastructure is considerably different from that of SSA. If the results are the same, it would bolster the strength of the contributions that our initial SSA study offers. However, if LA experts in e-business indicate a different constellation of factors affecting e-business in LA, then carefully analyzing their qualitative comments should yield valuable insights as to the specific contextual limitations of the effects of various infrastructural elements on e-business in these regions.

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Development of a Computer-Based PHC Management System: Towards a Holistic System

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ABSTRACT

This paper describes the research focus of the Nigerian part of a four-country project on Informatics Development for Health in Africa (INDEHELA), funded by the Academy of Finland.
Almost every segment of society is deriving enormous benefit from the use of Computer. Yet the health sector in most developing countries is probably the only sector lagging behind in the use of computers unfortunately there is no human who does not visit a health care professional sometime in his life time. In hospitals where computers are in use, it is for accounts, e-mail or word processing, very few are using computers for the day-to-day working of their medical establishments. This is believed to be as a result of non-availability of system that meets the required specification. Experience has shown that healthcare software developed for industrialized countries do not fit African healthcare facilities' requirements, at least without major re-design.

Hence home-grown software packages for Clinical services are becoming popular in Nigeria. This paper presents one of such systems, an outcome of INDEHELA_Methods research project, the Made In Nigeria Primary and Hospital Information System (MINPHIS). The current project INDEHELA_Context in Nigeria is focusing on a number of other INDEHELA_Methods outcomes one of which is the further development of MINPHIS to incorporate Primary Health Care (PHC).

The people resources in software development are identified. From experience the tools, techniques etc needed for IS development are often readily available except for the people, especially the software developers. Hence the focus is neither the tools nor techniques but in raising the human resources needed to accomplish the desired task of developing a computer based PHC management Information System (IS). The strategy for acquiring the human resources is discussed.

BACKGROUND

Information is widely recognized as the bedrock for appropriate health care planning and evidence-based policy formulation and implementation in all development sectors. For effective PHC performance, the availability of up-to-date information to guide decisions and activities whether within the community or network of health facilities is crucial (Alexander, 1992). Concerns about the health management information system (HMIS) in Nigeria and its negative impact on the functioning of the health system have been documented over the years. According to the 1988 National Policy on Health, "the planning, monitoring and evaluation of health services are hampered by the dearth of reliable data on a national scale. The basic demographic data about the size, structure, and distribution of the population are unreliable" (FEDERAL MINISTRY OF HEALTH, 1988). While the HIS within the Nigerian sector has evolved through a number of stages since the 1980s, and a relatively clear picture of a HMIS now obtains on paper, the functioning of the system remains poor till date. Strengthening the health information system currently constitutes one of the agendas under the health sector reform programme (FEDERAL MINISTRY OF HEALTH, 2004).

Personal computers have been deployed to the Nigerian economy but mainly for word processing, and recently electronic mail has become an important means of communication. Hardly is it used to facilitate healthcare delivery and management. Some hospitals are beginning to appreciate the positive impact Computer technology could bring to healthcare delivery management system. To get the appropriate computers is no more a problem especially now that the prices are dropping by day but the software systems that will drive it continues to be a major concern. There are options open for acquisition of the appropriate software packages. However, all the options hinge on human resources. Our experience in developing MINPHIS showed that healthcare software

developed for the requirements of industrialized countries do not fit African healthcare facilities' requirements, at least without major re-design.

The overall research questions behind the INDEHELA program are: How can African healthcare facilities and healthcare management get software applications that enable them to use ICT to provide better healthcare services for the people? What are the potential roles of local information systems (IS) professionals in the software service chains? What are the characteristics of appropriate software? How to ensure that computer-based information systems in healthcare in Africa will be sustainable and affordable, and will have a positive long-term impact on healthcare services? What kind of education of ICT professionals and healthcare professionals is needed to support these objectives?

In Nigeria, the project was established between the Computer Science and Engineering Department, and Community Health Department of the Obafemi Awolowo University, Ile-Ife, Ife Central Local Government, and the University of Kuopio, Finland. The paper present the initial research findings and the future plan of the Nigerian team.

MINPHIS

MINPHIS was deployed about 10 years ago at Obafemi Awolowo University teaching Hospitals complex as a pilot site. Its main goal was to collect, store, process and communicate patient data. Today, MINPHIS is based on Client-Server technology which, in the simplest set-up, can be installed on a single computer with the input and output devices. In its complex form it could run in environments like Local Area Network or Wide Area Network connected to the Internet where different users at different locations may have simultaneous access to the system. The effective running of the package developed began in early 1991. It was developed as a joint project between University of Kuopio in Finland (UKU) and Computer Science and Engineering Department, Obafemi Awolowo University with the sister Institution, the Obafemi Awolowo University teaching Hospitals Complex (OAUTHC) as a test bed. The development was based on the US Veteran Affairs (VA) public domain Hospital Information system. The VA developed a set of tools and also used the tools to develop Patient information systems in the mid-1980 for the VA hospitals. The tools comprised of FileMan database management system and the Kernel utility software built on M technology. The VA tools set with the Patient Information System were available as public domains now referred to as open source or free source. The VA package was adopted as a model in the research for a number of reasons:

1. the UKU has experience with the VA applications, FileMan, Kernel and a number of the VA application packages were available in the public-domain software,
2. FileMan out-performs commercial relational databases in complex cases since it is a network DBMS, not relational by physical design, and makes use of efficient physical storage of M technology.
3. Many hospitals in the US (170 VA hospitals), Egypt (National Cancer Institute), Germany, Pakistan etc use the same technology.

The VA application package had to be adjusted to suit the Nigerian Hospital requirement. Initially, it was believed that the modification will not be heavy since hospital practice is quite similar and the VA package was a good starting point but it was discovered that there was so much to be done as the VA hospitals differ largely from the OAUTHC. For one, VA is a military hospital, consequently, the package has its own peculiarities which for a public Teaching hospital were not useful, besides, FileMan and Kernel software needed to be localised to Nigerian requirements e.g. US date format should be modified to the Nigerian date format (Soriyan et. al, 2002). The program files and the database had to be modified. After the heavy modification to the original VA package and some new modules had to be developed, the first hospital computerised Patient information system was produced after a couple of years. The experience in modifying the VA system has shown that healthcare software developed for industrialized countries do not fit African healthcare facilities' requirements. In fact, the system could have been completed much earlier and easily if it was a fresh system development.

The data entry functions comprise patient registration, admissions, discharges and transfers, and discharge summaries. Some of the most important outputs were the Daily Bed Status and the Monthly/Annual Return of Morbidity and Mortality based on the ICD-9 codes. The recent version of the package however has incorporated the ICD-10 codes.

Designated users were selected from the Medical Records department of OAUTHC and were trained first on the use of Computers, since it was the first time most of the officers had to use a computer, thereafter on the use of the package. The experience has been documented elsewhere (Soriyan 2004, Korpela, 1994).

MINPHIS has since been deployed to a number of Nigerian Teaching hospitals and some Specialist Hospitals. Almost all doctors that have used the package realise the advantages of using computers, although a significant number are still awed by computers and harbour a number of myths. e.g. *Computers are for technical people, one must have appropriate training and have easy access to one, one must be able to type to use a computer* etc. The development of the system was phased; emphasis was more on the inpatient subsystem. Systems requirement analysis was ad hoc but participatory in nature. No official requirements were prepared for the developers, but key members of Medical Records' staff were available to respond to the developers' questions. Effort was on developing a software package that is quite similar to the manual procedures so that the users are quite comfortable using the system. Hence the Patient case note folder was replicated as much as possible except for a few changes, for example states were selected from the database. Replicating the manual system with minimal change was short lived, because the situation later changed; there was demand to incorporate other requirements outside the patient information.

In 1995 the project was reviewed. It was agreed that expansion was necessary to cover all major clinical areas of the hospital to achieve full clinical benefits. The expansion was such that more feedback reports were generated to the clinicians and since the OAUTHC is a referral centre for primary health care (PHC) and technically a resource centre for the effective operation of the package should be expanded to support the primary health care level as well.

The study also showed that a computer literacy course for all hospital staff should be organised. Courses in fundamentals of computing, together with an introduction to the hospital's own HIS was offered in batches. The training showed a significant difference in how Computers are perceived, also MINPHIS level of usability as well as impact increased significantly and a number of benefits were recorded especially by the doctors and researchers. This was short lived; a few years back a researcher visited OAUTHC to find out the possibility of recommending the system to other countries in Africa. He checked the database and a few output was generated. He reported that the latest information on the system was about 5 months old although the system was switched on daily with a few staff in the office. The staffs were still proud to say the hospital is the first to be computerized, and they have a stake in the project. This gave a signal that the system at the OAUTHC is being reduced to a status symbol. The package was being underutilised. This is quite different from other hospitals that have implemented the system.

The team visited one other site to inquire about other modules to be added, a member of management addressed our team and said *'we want to partner with you and market MINPHIS. From my office I can login to other access the information just like my other staff...we are planning to purchase our VSAT so we can also be linked to the Internet apart from the LAN.....but it has not addressed all our problems...our Primary Health Care has not been implemented ...'*. This is an indication that the system is not only being used and evaluated by the end-users alone but also by the Management that desire more modules and more measurable impact on the institution.
Apart from expanding the package, our team is also interested in assessing the impact of the computerisation in the institutions where MINPHIS has been deployed as we discovered that not all the modules in MINPHIS has been used, and where they are used, the impact on the management has not been evaluated.

By early 2001, a second-generation version of MINPHIS was developed with a new interface to the old in-patient database and was implemented at two hospitals in July 2001. The package was further enhanced and the system was prepared for deployment to other hospitals in Nigeria. Today there are six Teaching Hospitals in Nigeria that has implemented MINPHIS. The emphasis is to expand the package to cover PHC. However, a number of initiatives have been reported, the next section reports the initiatives.

THE DEVELOPMENT OF COMPUTER-BASED PRIMARY HEALTH CARE INFORMATION SYSTEM LEVEL: PREVIOUS EFFORTS AND OUTCOME

Nigeria has witnessed several efforts to improve the state of the national health information system in the last two decades. The Federal Ministry of Health (FMOH), at the early stages of Primary Health Care implementation in Nigeria, for example initiated a Health Information System in 1987 (Oyegbite, 1992). The system included mechanisms for collecting data at household, community and facility levels. At the community

level, home-based cards were introduced and a pictorial method of health record was provided to community-based health workers such as volunteer health workers. At the local government level, specifically, the following were identified as important elements of the health information system: recording, monitoring, evaluation, and supervision. Alongside this initiative, a system for improving disease surveillance was also initiated in order to improve, among others, the reporting of diseases and facilitate prompt responses. While this system has the potential to generate the data set required for effective PHC, which as identified by Iwunor (1992) include demographic data, health status data, health services data, and health resources data, the system was not able to achieve the desired objectives due to logistic and managerial problems. Despite the health information system put in place by the government, a number of different data collection instruments and parallel system was being operated by various development agencies in the country.

In a bit to streamline the flow of information and improve the availability of quality health-related data, a revised system – the National Health Management Information System (NHMIS) was developed in the mid-1990s. The process of its development featured extensive consultative sessions between the FMOH (represented by the then Department of Planning, Research and Statistics) and the development partners (particularly the United Nation Agencies). The NHMIS, as part of the effort to ensure the collection of a large variety of data and to satisfy a wide range of users, developed a large number of forms. While the system has the advantage of being able to capture wide array of information, the practical disadvantage is that it takes significant efforts, patience, and time to complete the forms at the facility level, and quite cumbersome, tiring and slightly complicated to coordinate at the PHC level. As part of the plan to ensure that the coordination of the data at various levels is undertaken smoothly and efficiently, there was an initiative to develop a software package that would be widely distributed nationally to handle such operations. Works on this software named HIFA (Health Information for Action) progressed considerable in year 2000, but till date the software is yet to be available within the public health sector. Thus, Nigeria so far has little or no experience of note regarding the use of software as part of the health management information system within the public sector facilities. Yet, as reflected earlier the plans in that area have not seen the light of the day. Indeed, plans and thoughts towards a computer-based HMIS was one of the major highlights in a national conference on health information system convened by the Federal Ministry of Health and Social Services (as the ministry was then named) in the early 1990s (Makanjuola, 1992).

These are, however, useful experiences from other parts of sub-Saharan Africa from such countries as Ghana, Tanzania, Uganda, and South Africa that underscore the importance and advantages of a computerised health information system. In the Tanga region of Tanzania, for example, a computerized HIS has been introduced, and this resulted in a substantial increase in the reporting rate from regional to national level from 26% in 1997 to 99% in 2000 (Regional Medical Office, Tanga, 2004). The HMIS in the region is computerized at district level in the areas of data entry and production of reports. Most of the health information collected from health facilities is forwarded from the district to the regional level on floppy disks. In turn, there are computerized feedback reports from Regional Medical Office to the District Medical Offices. The system has a data entry and reporting tool for "supervision checklists" used at district level and there is a computerized automated planning software according to the "Format of Comprehensive Council Health Plan" used at district level. The checklist is based on MS-Access while the planning software is designed based on MS-Excel.

In the South African experience, an experimental scheme in the computerisation of the PHC services using three approaches at clinic level have been reported in the literature (blignaut and McDonald, 1997). While the first approach utilised a system based on head-count using a minimum set of indicators, the second and third approaches involved computer systems that are based on patient records with the second approach based on a very limited data set compared to the third that utilized a comprehensive demographic and clinical data set. A comparison of the approaches showed that although the patient-record approach was more time consuming, it was more flexible and preferred. Furthermore, the second approach (with more limited data set) was considered more feasible in a developing country where most health staff are computer-illiterate.

In a more recent example, the District Health Management Team (DHMT) at Berekum District of Ghana introduced a computerized HMIS in response to some practical problems that were being encountered in the district health administration (Ofosu, 2004). Among others, the work of the district health administrator was being hampered by late submission of reports from the various district programme officers to the District Director and to the Regional Health Team. The district health management team (DHMT) also documented inadequate information sharing among team members, and difficulty with use of health information and data for management decision-making. The DHMT noted that the collection and management of health care delivery data consumed valuable staff hours and yet resulted in the production of inaccurate reports.

The DHMT identified the drug stock management and data collection and analysis as two priority areas for improvement through computer-based interventions. Computer-based information system was subsequently developed for the management of drugs and supplies at the medical store, which enabled users to undertake record transactions between the district medical store and the regional medical store, on one hand, and record transactions between the district medical store and the community clinics, on the other hand. The system also automatically creates reports on the medical store inventory and financial status as well as raise pre-arranged alert signal when any drugs or supplies become depleted beyond an acceptable limit. The system also facilitated direct entry of service-related data into the computer and subsequent analysis and generation of reports, including graphical outputs.

Based on the use of the computerized system, between mid-2002 and mid-2004 the District Medical Stores was reported to have been able to achieve prompt reporting of monthly drug stocks to the regional office with 100% accuracy compared to the previous situation whereby reports were 2-3 weeks late with an estimated 75% accuracy. With prompt and accurate reporting achieved with the use of computerized system, the DMHT was in a position make informed and critical decisions on procurement of drugs before the stocks reach critically depleted levels, and accounting process was greatly improved because of the real-time view of the stock value and available funds. The DHMT also reported increased efficiency and accuracy in the management of health care delivery data and reduced number of hours spent collecting and aggregating health care delivery data. Furthermore, it became possible for the DHMT to create accurate and forward timely reports to the regional office, and to use the output of the data analysis to identify public health needs and to plan future service delivery.

The system at Berekum district, however, experienced problem with regards to the transfer of data from the clinics to the district levels electronically. The effort put in place was to use Personal Digital Assistance (PDA) at the clinic level to record the data and to subsequently download the entered data to the computer system at the district level. However, the PDAs were found not to be optimal in the local environment as they needed recharging at a faster rate than originally anticipated which constituted a problem in situations or locations where there was no regular electricity supply. The capacity of the PDAs was also limited in terms of memory with the result that only the data on immunization could be entered into them. The PDAs also proved unstable with regards to the software loaded.

However, appropriate software packages for African hospitals and health centres cannot be found off the shelf – the requirements are too different for an African hospital to be able to benefit directly from an American or European hospital application without major adjustment and the situation is even more problematic in PHC. (Soriyan, 2004).

The Nigerian Primary Health Care delivery system has not enjoyed proper coordination and data collection over the years, thereby creating an incomplete and unreliable health data. According to Korpela et.al. (1998), the available data in Nigerian health care delivery shows there is lack of information and lack of appreciation for data.

DEVELOPING THE PHC COMPONENT OF MINPHIS

Some developments agencies though have come up with software packages (on short-term and intermittent basis) to capture, store and process PHC data but the end of their programmes have also terminated such efforts. It seems such agencies have their own designed programme focus and once achieved they have no stake in the system anymore. As such, there is no long term impact on the health system and the community, worse still the personnel working within the system seem to be empowered to be useful only as long as such projects last. The information system on ground thus remains manual and crude (Soriyan, 2004), giving rise to inaccurate and unreliable data.

Consequent upon the conviction that computerized PHC is feasible in Africa, there is the need to incorporate the PHC component of MINPHIS. Earlier experience has shown that training on computer awareness and IS-use will be an advantage even in requirement analysis and system evaluation. Therefore, the research team has scheduled an IS training. Thus awareness on the value and use of information is expected to be created through workshop and training programmes for the potential clients. The huge expenditure being incurred in the acquisition and use of IT, and the failure to realize comparable socio-economic returns from such investments is another reason the Nigerian research team has planned to investigate the impact of CBIS by evaluating IS-use in selected MINPHIS

sites where Primary Health care facilities are made available for the patients. Following this training, IS-use will be re-evaluated in the sites to determine (1) the impact of the information derived from MINPHIS implementation, especially on how the information has been used for management decisions, and (2) How has the adoption of MINPHIS affected the entire hospital system (3) How has the adaptation of MINPHIS affected the information processing, (4) the aspect of PHC to be developed (5) who are the possible stakeholders and what are their roles (6) what are the information gathering process that will enhance the development and the expected project outcome (7) what should be the mode of deployment. The focus of the healthcare part of the project is depicted red in figure 1 below

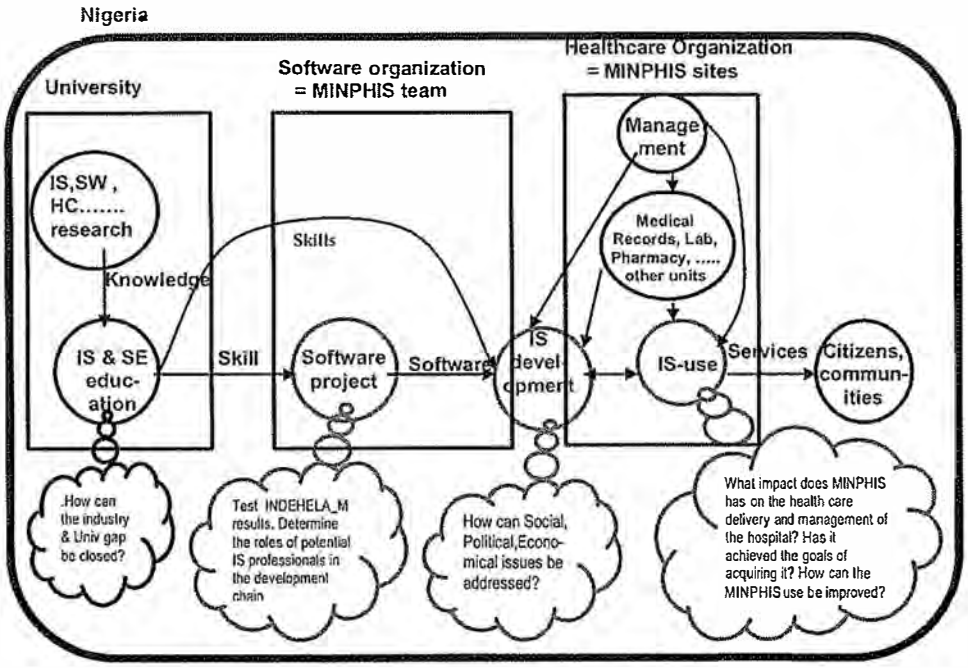

Figure 1: Healthcare Research Framework

The research team will also study the existing Primary Health Care Information System and analyze the existing manual primary health care information system so as establish an appropriate Primary Health Care Information System which will serve as an improvement over the existing one and an improved system for primary health care that will enhance adequate feedback to the stakeholders will be proposed. For the purpose of generating accurate and consistent information, centers that participate in the training will be the first to have the computer-based PHC installed and tested. Once the system is satisfactory, it will also be implemented at the coordinating unit of the local government area (LGA). A model developed by Soriyan (2004) will be used in the system development with the aim of validating the model.

Preliminary investigation of the PHC management at a Local Government shows the following problems, among others:

- Lack of accurate basic health data as a result of haphazard data collection and or poorly managed system
- Inadequate use of utilization of data for decision making
- Disjointed pattern of information flow among PHC providers, resulting in inaccurate dissemination of information
- Lack of information feedback to patients
- Poor referral pattern and information flow between PHC and upper levels of care
- Report generation is slow, tedious and often inaccurate

Much as the cry for a better and reliable information system in the health sector, the human resources is a main sting that has attracted very little attention.

THE PEOPLE RESOURCES IN THE DEVELOPMENT OF COMPUTER BASED INFORMATION SYSTEM

Given an organizational and IS project context, people and methods are the basic inputs to the systems development process. People in this context are the IS developers and the IS users (Palvia and Hunter, 1996). In this context, the IS developers are the project manager, system analyst, Community health consultant, and programmers, while the IS users include the Monitoring and Evaluation officer, PHC coordinator for the Local Government, and Chairman Local government.

The project manager is the project coordinator. System analysts will be a student working on his Masters certificate within PHC, and the Supervisor who is also the project manager, Community Health consultant is a lecturer and also the co-supervisor, and programmers are being sought from the students of Computer Science and Engineering while the IS-users are people holding such positions as listed above.

The research team has established a working relationship with the officials of Ife Central Local Government, and the personnel at the PHC centre. Ife Central Local Government Area, Enuwa, Ile-Ife. During the preliminary session with the officials of the PHC in the Local government the team was able to gather information on the existing state of the information system at the primary care level at the LGA level, the pattern of information flow, the various reports generated, problems and limitations in these areas that may necessitate the introduction of computer. The meeting has provided a ground for approaching the Local Government authorities to set the stage for the development work.

The rapid assessment conducted so far has revealed the following:

- People do not use information
- Information to be used is not available
- People do not appreciate the importance of information
- People do not see any benefit of the information collected
- Information is not seen as a planning or management tool
- No time picture of actual stage.

CONCLUSION

This paper reports preliminary work in one of the INDEHELA_C research agendas and the strategy for producing viable team members. It presents the computerisation efforts in some developing countries with emphasis on the Health sector in African countries and insinuated that Nigeria Health Sector cannot be different. MINPHIS development, improvement, and plans for its migration to a complete system are presented. It presents the research setting.

This is a research in progress paper, so it is too early to make any conclusive statements. This paper is based on research funded by the Academy of Finland through the INDEHELA-Context project, grant no. 104776 (2004-2007).

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The Evolution of a Framework for Assessing Hospital Information Systems in South Africa

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ABSTRACT
This paper provides an insight into the process of an ex-ante or exploratory assessment of Information Systems (IS) in hospitals in developing countries. Based on a case study of an assessment process conducted in 13 hospitals in the Province of Eastern Cape in South Africa, the paper creates two contributions. Firstly it supports the claim that prior-to-implementation assessment of IS in developing countries are of vital importance in order to reduce the risk of failure. Secondly, elaborating on the findings from the case, it contributes to the ongoing epistemological discussion around positivist vs. interpretivist approaches in IS evaluation. We submit that a balanced approach is necessary, where the balance is determined by contingent factors of the context of work.

1. INTRODUCTION
This paper provides an insight into the process of an ex-ante or exploratory assessment of Information Systems (IS) in hospitals in developing countries. Drawing on the existing body of literature on IS evaluation, the paper positions itself inside the discussion around positivist vs. interpretivist evaluation approaches (Hirschheim & Smithson 1999). The research presented here finds its motivation in the acknowledgement of the relevance of conducting a proper exploratory assessment of the situation. This phase is particularly important when preparing IS implementation projects in developing countries (Forster & Cornford 1995).

The aim of the paper is thus to address the challenges and opportunities implicit in an assessment prior to implementation and to elaborate the findings within the above mentioned ongoing epistemological discussion in the IS evaluation community. The contribution of the paper is formed by a case-study based insight into the importance of the assessment phase in support of Forster and Conford's view, and by the conclusion that a balance is needed between positivist and interpretivist approaches, and that this balance depends on the contingent characteristics of the context of work.

The paper is structured as follows. First we will provide a review of the relevant literature in IS evaluation in general and in the specific case of developing countries. Secondly, we will describe the methodological approach. Thirdly, we will present the case. Then we will summarize our findings in the discussion section. Finally, we will draw the conclusion of our research and suggest topics for further research.

2. LITERATURE REVIEW
In this section we will go through a review of literature on IS evaluation. In particular, we will position our paper within the discussion around 'exploratory' or 'ex-ante' evaluation (Smithson & Tsiavos 2004). Referring to an ongoing discussion on the future trends and directions of research in the IS evaluation field, we will also raise some issues based on the case presented here which will be addressed in the discussion section. We will then highlight the main challenges of IS projects in developing countries and the crucial role of pre-implementation IS assessment in addressing these challenges.

2.1 IS Assessment and IS Evaluation
This paper investigates the nature and the role of a pre-implementation assessment phase of an information system. Broadly speaking, an assessment of an information system falls into the more general theme of IS evaluation. Smithson and Tsiavos define IS evaluation as "[...] an act of categorizing, classifying, and reducing

the world to a series of numbers – or constructed classifications – to enable this representation to be compared and managed [...], thus to be able to function as the basis for rational decision making" (Smithson & Tsiavos 2004). By creating representations of the reality, the evaluation provides a "basic feedback function" to managers and it constitutes a "fundamental component of the organizational learning process". It is hence "essential for problem diagnosis, planning and the reduction of uncertainty" (Smithson & Hirschheim 1998). (This is also discussed in Angell & Smithson 1991; Symons & Walsham 1991; Hawgood & Land 1988).

However, IS evaluation is a process which may interest the whole life-cycle of the system (Hirschheim & Smithson 1999). It is thus worthwhile to differentiate, for example, the nature and role of an evaluation prior to implementation from one after the implementation. In particular, this paper deals with IS assessment as a form of *ex ante* or 'exploratory' evaluation. The purpose of a pre-implementation IS assessment is to provide a picture of the past and present situation in order to inform future decisions. That is, it is the "the construction of a possible future" by inscribing it into the present and future decisions of the organizations (Smithson & Tsiavos 2004).

While the review presented above helps to understand the purpose of a pre-implementation evaluation or assessment, it remains to be clarified 'how' the assessment can be done. It is here important to underline that an evaluation of an IS is in fact an evaluation of a 'social' system (Walsham *et al.* 1990; Hirschheim & Smithson 1999). This observation has practical implications at least in three directions:
(1) no matter how detailed and structured the set of criteria or categories of the evaluation, their mere measurement and quantification can hardly provide an objective representation (Mason & Swanson 1981);
(2) as social systems evolve over time and space, their evaluation at any point of time cannot have a long term validity;
(3) social systems are also political systems which make the evaluation process itself a political activity (Smithson & Hirschheim 1998; Wilson & Howcroft 2000).

These challenges have so far guided the research on IS evaluation to explore different epistemologies and ontologies to investigate its nature. As a result, IS evaluation approaches stretch along a continuum ranging from highly objective and rational approaches to very subjective and political ones. Accordingly, the first type of approaches tends to build on positivist investigation, while the latter encounters and represents reality through more phenomenological and interpretive explorations (Hirschheim & Smithson 1999).

This epistemological question is still open and is built on the evidence that the excessive concentration on tools and techniques to objectively categorize, measure and quantify reality finds its limits when applied to social systems. The validity of the positivist stance (which so far received most of the attention of the research community) is hence questioned in favor of the introduction of a phenomenological one (Hirschheim & Smithson 1999).

We wish here to position this paper within this discussion and raise some issues which we will address in the discussion section. The case presented here provides a rich insight in the motivation and learning process of a pre-implementation IS assessment. The evidence will show that an initially positivist approach needed to be changed into a mixed positivist and phenomenological one which could integrate undisputable hard facts with social, political, and behavioral aspects of the IS. We will reflect on this learning process trying to contribute to the ongoing discussion with insights into real world practice and needs of an IS assessment. Specifically we will try to understand which approach better serves the particular needs of an assessment of health IS in developing countries.

In the next section we will review some of the literature related to IS evaluation and assessment in developing countries.

2.2 IS Assessment in Developing Countries

IT/IS implementation projects in developing countries are often seen as integral parts of development policies. Yet, the particular environmental and infrastructural conditions found in developing countries set considerable challenges to the successful completion of such projects. There is an often lacking physical infrastructure, deficient local human capacity, high turnover of staff, and poor socio-economic conditions. Last but not least there are also different cultural backgrounds which need to be taken into consideration (Bell & Wood-Harper 1990). As a result, any IS implementation must carefully take into account the social environment in which it is pursued (Walsham *et al.* 1990; Wilson and Gouws 2003; Lippeveld *et al.* 2000; Littlejohns *et al.* 2003).

In this setting, the evaluation of an IS can be seen as a way of reducing the uncertainty, acquiring local knowledge, and thus increasing the likelihood of success of the implementation. Understanding as much as possible before implementation is initiated, is important to ensure that implementation strategies are appropriate and take into account the socio-economic realities. Should failure result, the effect of wasting scarce resources carries a far greater cost than that of failure in a well resourced setting. Forster and Cornford (1995) underline how "[...] evaluation of prior systems development work and of other projects in the domain is thus vital to inform the developer and to permit enhanced planning and management functions".

While some authors do provide specific frameworks for conducting the evaluation in these settings (Forster and Cornford 1995; LaFond & Fields 2003; Lippeveld *et al.* 2000), we will here not focus on those specifically. Rather we will focus on the purpose and content of the evaluation and try to explore more in depth and in detail 'how' it can increase the likelihood of success of health IS implementation in developing countries.

3. METHODOLOGY

The research described in this paper falls within the interpretive research tradition described by Walsham (1995). The research describes the development of a tool for assessing hospital information systems.

The case study was conducted in a period of four months and involved assessments of information systems at 13 hospitals. It also draws on the experience of one of the authors (Shaw) in assessing hospital information systems in two central hospitals in Malawi (this work spanned a nine month period and involved about 10 weeks spent on site in these hospitals).

The data was collected directly observing or participating to the process. The process has been an iterative one, utilising participatory research methods (small group discussions, focus group discussions, reflection and analysis) to build on the experience of a wide variety of individuals (both information systems consultants and health workers and managers) from differing backgrounds and professions.

Data sources include:

- Notes written by one of the authors (VS) as part of the process of conducting evaluations;
- Mini-disc recordings of meetings and discussions held during the evaluation process;
- Written reports following assessments, and notes, documents and copies of reports obtained during the assessments;
- Observation of health workers in their daily activities;
- Photographs taken during the hospital assessments.

4. CASE STUDY

In this section we describe the context in which the case study is situated, and a brief overview of the circumstances that led to the initiation of the project. The main focus however is on the development of an assessment format and this is described in three sections – the first assessment format, the experiences of applying the format, and how this influenced the need for a more open format, and the development of the subsequent format. The end of the section summarises the learning from this process and suggests an approach that might be adopted in future.

4.1 The context of the case study

The development of the assessment format took place in the Eastern Cape Province (ECP) of South Africa. This is a predominantly rural province, with health inidices similar to those in other developing contexts (the infant mortality rate (IMR) is around 61.2 deaths per 1000 live births (the highest in South Africa, which has an average IMR of 45.4). In this province there is a 48% unemployment rate, only 31% of people have access to electricity, and 24% of homes have water in the dwelling (SADHS, 1998).

Hospitals are graded according to the level of care that they provide. District Hospitals are the first level of hospital care, and provide care to patients referred to them from the primary health care facilities. District hospitals refer patients to regional hospitals, which are the second level of care provided in the system. Regional hospitals generally employ specialists to provide more sophisticated services. Specialised hospitals provide

specialised care to a select group of patients (psychiatric care, tuberculosis patients are examples of these types of hospitals). The development of the assessment format took place as part of a twelve month project designed to improve access to information, and its use by managers in thirteen hospitals– nine of these were regional hospitals, two were specialised hospitals, and two were district hospitals.

4.2 Hospital information systems used in the ECP

Hospitals in this province have rudimentary information systems. None of the hospitals in this province use electronic patient information systems. Patient records are paper based (patient files for records of treatment and care provided), and the information system is also largely paper-based. Essentially the steps in the process of generating information in these hospitals consist of the following:

1. Use of registers to record certain pieces of information from a patient interaction with health service providers. This takes place at most points of service delivery. The service delivery points are termed "reporting units" – being sources of raw data for the information system. The information that is recorded in the register is usually information about the patient (age, sex, residence, etc, as well clinical information like diagnosis, outcome and types of procedures performed);
2. The generation of a monthly summary report from the register. This contains anonymous, aggregated patient data (total numbers of patients seen, numbers of patients seen with certain diagnoses, or in certain age groups), and is sent to the management level;
3. Collation of the information into a hospital report format. The report format contains raw data collated from the reporting units, and aggregated to hospital level;
4. Submission of this information to the provincial office where it is entered into a database for analysis and use.

There is little feedback, and very little use of information at either reporting unit level or management level. The flow of information is generally unco-ordinated and often results in incomplete data at the management level.

The project was designed to address these problems. It was envisaged that the paper based system of collecting information from patient interactions would continue, but that the monthly summary report would be entered into the database at a central point in the hospital. This would enable the raw data to be processed at the hospital, and would enable the production of reports to reporting units as feedback), and to management.

The project design included three phases (see table 1).

Phase	Project activities
Phase 1	1. Assessment of the existing information systems in the hospitals; 2. Define an Essential Dataset (* see endnote) for the hospital services in the province, and for each hospital; 3. Proposing a data flow policy, including the roles and responsibilities of staff in the information processing cycle; 4. Refinement of data collection tools for the reporting units; 5. Customisation of the District Health Information System (HISP) software to accommodate all the reporting units in the hospital – this with the aim of enabling the hospital to collate and analyse its own data; 6. Developing a training plan
Phase 2	1. Installing the customised database in the hospitals; 2. Provide training to selected groups on the use of information; 3. Overseeing the ongoing customisation of the database.
Phase 3	1. Provide ongoing support for the development of the information system in the hospitals; 2. Conduct an assessment of the implementation process to highlight lessons learnt from the project

Table 13 Phases designed in the project

The case study description focuses on the assessment of the existing information system in the hospitals (phase 1) and briefly draws on lessons learnt from the assessment of the implementation process (phase 3) that are relevant to conducting an assessment at the outset of such a project.

4.3 The first assessment format

In preparation for the assessment, a few members of the team prepared an assessment format. Based on the ultimate goal of the project (achieving the regular production of complete and reliable data reports from the hospitals) the team focused on the three objectively essential factors that needed to be in place. Firstly, all the necessary data (the ones defined in the National EDS) needed to be collected. Secondly, there had to be some form or tool to collect them. Finally, there needed to be one or more persons appointed to take care of the process and its outcome. The need of these three preconditions was reflected in the first version of the assessment tool. In this first stage, the assessment process included a preliminary meeting with the management. During the meeting the project was supposed to be introduced and a complete map of all existing reporting units (that is wards where data is collected) was created. The next step was to meet with the information officer, if there was one appointed in that hospital. Subsequently, the assessment team would visit the reporting units one by one to assess if data from the EDS were collected and how. The assessment tool allowed reporting this by providing a list of the data elements on the left and a space for ticking on the right. The general assumption behind this assessment approach was that it had to be a hard fact: either that data was collected or it was not.

The first pilot assessment was conducted at two regional hospitals.

4.4 Experiences during the pilot assessment:

After conducting the assessment, the project team met and discussed the usefulness of the tool and the appropriateness of the approach. Overall, the team found the assessment tool limited. The remarks underlined how the tool was too focussed on the reporting of data, and did not make allowance for recording innovation, human interactions, and the impact of different processes to be recorded. It became apparent that while assessing the hard fact of whether a certain data element was collected or not was certainly relevant, even more important, for the success of the project, was to understand why it was not or why sometimes a clear answer could not be given. Here are some examples of observations made by the team regarding the situations they have been assessing:

- Data collection was "too dependant on individuals....when this person is absent, data does not get collected".
- Doctors and nurses had different needs for information, and often the needs of doctors were imposed on those of nurse, without taking into consideration their needs (an example was cited where an orthopaedic doctor had introduced a new data collection system to address his specific needs)
- Requests for information came from different sources (district management, provincial management, national management) and because there was no co-ordination of these requests, health care workers were left to find ways of collecting information that often resulted in duplication (one ward submitted three different formats of the same "mid-night census" form to different people) of data.

All these snapshots provided useful insights which could all together give a "flavour" or a "gut feeling" of what was going on in the hospital. The assessment format at this stage did not allow for this rich information to be reported. Hence a format was required which would provide both the possibility of assessing more objective aspects of the existing information system and of describing the process behind them through the documentation of the explorative understanding of the assessor.

In summary, the following comments were used as a basis for redesigning the assessment tool and approach:

- It was more important to start from the perspective of "what data is being collected" by the reporting units, than "what data should be collected by the reporting units". This reflects a significant shift from being focussed on the needs of the system (reporting according to the EDS) to rather focussed on what is happening at the service delivery point. In many instances the reporting units were collecting most of the data required in terms of the National EDS, or they could adapt their systems easily enough in order to accommodate the requirement of the National EDS.
- The above point also reflected a shift in the teams' thinking. The initial thinking was to ensure that the correct data was collected – this reflected an implementation centred approach that was initially adopted by the team. However, as the interactions occurred between the team and the health workers, the team found itself naturally moving into the role of trying to understand why data was or was not collected by the health workers, and how they used the data that they collected. This reflected a more health worker centred approach – an approach that should be developed in order to understand the health workers, so that the recommendations that resulted were appropriate to their needs. The team realised that the assessment process was not an isolated step in the implementation process, but in itself it contributed to the initiation of the implementation process as well as informing the implementation process.

• Finally, during the assessment some interesting local innovations were discovered. For the success of the project, building on and disseminating such innovation also among the other hospitals was seen as highly relevant. The assessment had to allow for such things to be documented.

4.5 The second assessment format

Based on the experiences during the pilot assessment, a second format for assessing the information system was developed. It was much more generic, and could accommodate peculiarities and innovations found in the reporting units. It assessed two main aspects for each reporting unit:

- Data collected and the tools associated with the data collection process;
- Reporting process and the forms used for reports.

In order to allow assessors to add, when necessary, their interpretations of how the above was happening, the new format accommodated the possibility to add comments to the two more objective aspects listed above.

The revised format was applied in each of the remaining hospitals. The same process was followed in most cases (introductory meeting with management, assessment of various reporting units in the hospital, compilation of brief report and feedback to management).

As a final step, the assessment team prepared a report and discussed the situation assessed in the hospital with the senior management. In these discussions, additional information from these groups was obtained on:

- the information received – usually confirmation of what had been found at reporting unit level;
- the actual use of information;
- staffing issues related to the processing of information – roles and responsibilities of staff (e.g. the use of information by supervisors).

4.6 Summary

In summary, we can see that the assessment team moved from having a rigid format for assessing an information system that was focussed on information requirements at a national (and provincial) level, to one which was more focussed on the tools used by reporting unit staff, and which allowed a more in depth exploration of the reasons why they did what they did. In addition, discussions with supervisors, senior managers, and information staff complemented the information gathered from reporting units to allow the generation of a report. This report provided both a "live" representation of the situation in the hospital, and a sense of direction to the forthcoming implementation and improvement. Table 2 shows the outline of the report which was generated. The structure of the assessment report already reflects the lines of action of the forthcoming implementation (AF refers to Assessment Format for data collection tools or reporting tools).

Table 14 Outline of the report generated after the assessment

3d. Reporting	Visit to reporting unit	Discussion supervisors, senior managers, information unit.
4. Data flow and use of computers	AF: Data Collection AF: Data Reports	Discussion Information Unit
2. Essential dataset	AF: Data Collection	
3. Steps in the information cycle:		
3a. Data collection	AF: Data Collection	Discussion supervisors, senior managers.
3b. Data collation and analysis,	AF: Data Reports	Discussion supervisors, senior managers, information unit.
3c. Data processing and presentation,	AF: Data Reports	Discussion supervisors, senior managers, information unit.

It was concluded that the process of conducting the assessments is as important as the data obtained; namely, the

introductory discussions with senior management to explore the process that will be followed, the discussions with staff in the reporting units, and the presentation of the report to management afterwards. The experience gained during this assessment showed that the assessment phase is intricately linked to the process of improving the system, and can both inform and contribute to the subsequent implementation and improvement process.

5. DISCUSSION

In this section we will explore the relevance of an ex-ante assessment, and how it contributes to the implementation process. We also explore the need to balance the assessment between positivist and interpretivist styles.

5.1 Importance of Pre-implementation HIS Assessments

In the literature review we suggested that, implementation of information systems in developing countries provides "considerable challenges" to their successful implementation. We suggested that through the process of conducting an assessment, a deeper understanding of local knowledge is obtained, and this assists in informing the implementation process. It also reduces "uncertainty" or the lack of knowledge about a system. This was our experience in this case study. In the case we describe the importance of getting alongside staff to understand what they do and why they do it that way. In doing this the team was able to:

- Identify best practices that worked in the context of that hospital, and which might be able to be shared and applied in other similar settings;
- Understand the dynamics around aspects of the information system that were not working, so that the intervention could address some of the core reasons for their failure, rather than the symptoms

In fact, often while the data to be collected and the processes around collecting the data can be decided remotely, the successful implementation of the data collection processes requires a deep understanding of the flow of patients through the wards, the positioning of staff at these points, and their ability to record information. In addition, an understanding of the culture within the unit and their commitment or lack of it to collect the information is helpful (e.g. does the supervisor look at the information, does she provide feedback on the information). This emphasises the overwhelming feeling that the team experienced during the assessment process, namely that the data and the systems to collect the data are a product of a complex social system. They are an external manifestation of a complex system of interaction between humans (health care workers and managers and their patients) and their environment.

Through conducting the assessment, we were able to gain a better understanding of the context in which the information system operated, and this not only informed our implementation process, but also changed the implementation methodology. We believe these changes were appropriate and contributed to a more successful implementation process.

5.2 Balancing Positivism and Interpretivism in IS Assessments

In the literature review we provided some background to the different types of information system assessments. We describe the continuum along which information system assessments are stretched, from the positivist (often quantitative) to the more subjective and political interpretivist approaches. The case study describes how the assessment approach was felt lacking when it focussed more on the positivist end of the spectrum (the first version of the assessment tool), and how the format changed to accommodate a richer understanding of the context in which the assessment was conducted.

We find in this case study in fact a need to balance both aspects of the spectrum in a single process. Both positivist and interpretivist approaches help to gain a deeper understanding of the system than either could do alone. Thus the quantification of the data collected, its completeness, and accuracy, the numbers of staff available to perform certain functions, and the size of the hospital, are useful pieces of information. However, this alone is insufficient. More information is needed about the functioning and systems behind these numbers. The need for this information is an inherent characteristic of human interaction, and flows naturally through the process of interaction.

If the positivist approach is utilised exclusively, one would record that ward X does not collect information Y. However, when exploring this in depth, one finds that there are many reasons why this information is not readily available, for example:

- The senior staff (in the case of the hospital, the doctors) may not regard this as important and so do not support the use of resources to collect that information;
- It may appear to be "not collected" because the person responsible is absent that day;
- Health workers (particularly nurses, and ward clerks) are subject to direct demands from many different people (patients, their immediate supervisors, their colleagues with whom they work – other member of the health care team who may be senior to them) and indirect demands from distant managers at district, regional or national levels, and the public in general. What information gets collected is a complex reflection of these demands, and their own needs for information.

All these explanations will turn out to be relevant piece of information when conducting the implementation of the improvement.

In conclusion, the evolution of the assessment format reflected:
- A change towards a more interpretivist approach (although the format included a more positivist assessment of the data collected) in that the tool allowed a more open ended assessment of what was happening, thus an approach that allowed greater exploration of the context in which the information was collected;
- A change towards a more "health worker centred approach" - looking at what tools were in use, and therefore what information is collected from one which concentrated on what was or was not collected, without exploring the reasons behind the action.

We see therefore that the assessment process should be sensitive to, and reflect the context in which the information system is developed. This process itself can result in change and can have an impact in improving the information system – this by virtue of the interaction that takes place through the assessment process. This of course is then intricately linked to the recommendations for implementation, which are more likely to be appropriate and to succeed.

6. CONCLUSIONS AND FURTHER RESEARCH

This paper provides a rich description about the process of developing an ex-ante or exploratory assessment format for information systems in hospitals in developing countries. We provide insights into the importance of conducting such an assessment in a hospital context, and argue the need for a balance between positivist and interpretivist approaches. We reflect on these aspects, and this is both the contribution of this paper and its limitation. We would suggest that areas for further research might include an exploration of ways in which an information systems assessment can be structured so that it contributes significantly to the successful implementation of information systems projects in developing countries, and the factors that would shift assessment formats along the continuum between the positivist and interpretivist approaches.

ENDNOTES

(*) An Essential Data Set (EDS) may be defined as a set of the most important data elements that should be reported on by health service providers on a routine basis, with the aim of being able to generate indicators that monitor the provision of health services in an integrated manner. It is usually determined by the National level of the Health Department, in consultation with the service providers. Each province should determine an EDS that includes the National EDS and additional data elements that are important for the province. Each Hospital should develop an EDS that includes the Provincial dataset and additional data elements that are relevant to the hospital management.

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Towards Knowledge Engineering for Expertise Retention in Developing Countries

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Abstract

There has much scepticism about the potentials of rule based experts in different domains of applications. This school of thought has been premised on the claim that experts work on the basis of intuition and association in reaching conclusions and not on the basis of rules. Rule based expert systems are a potential source of training and reference for budding experts. This paper describes a project that is aimed at exploring the retention of expertise in the form of expert systems in different domains. The project seeks to achieve an accurate elicitation of the expert knowledge, and consequently compare the conclusions of the resulting expert systems with actual conclusions of real experts. This is done with a view to determining the suitability of rule based expert system in different domains. We present a progress report on the project present work done on two domains. The first is the domain of drug reactions in which knowledge elicitation has reached an advance stage, while the other is on diagnosis of liver diseases, in which an expert system has being built which uses three different knowledge sources for reaching conclusions in each case. The liver diagnosis system has been tried on three actual case studies from a teaching hospital, and the actual diagnoses agree with the conclusion of an expert system using three different knowledge sources. We end the paper with a discussion of the future directions the project would take. Pertinent issues in this regard include: Validation and comparison of knowledge sources and communication problems in knowledge elicitation.

1. Background and Motivation

Expertise is crucial to any nation's quest for development. However, third world nations have been hit in recent decades by a dearth of expertise occasioned by the brain drain. This problem is being made worse by the fact that when many of the carriers of the expertise on which many of our academic institutions are built retire, they are usually replaced by personnel of a much lower level of experience in the field.

Consequently, the future of professionalism in very many fields is under threat in many third world countries. As such it is important to find a way of preserving the expertise of aged and retiring experts in very many fields of human endeavour in third world countries. As it turns out, much of the expertise required to function in the third world as an expert in many fields reside with experts who live and work in those countries.

Knowledge Engineering is a discipline that involves the formalization of expertise and its subsequent activation and preservation through Information Technology. One of the major challenges in knowledge engineering is the formalization of the experts' knowledge. Much of the expertise that an expert uses everyday is being used without being codified. For example it has been a long held belief in the knowledge based expert system research community that experts are guided by a hidden set of heuristic rules that exist without being formally known to the expert. As such a major task in knowledge engineering is to uncover those rules and formalize them. That task is known as *knowledge elicitation*. As such by "knowledge retention" in this paper, we refer to the elicitation and formalization of domain expertise in the form of expert systems.

Although it has been argued by Winograd and Flores (1986), that human knowledge and expertise may not by its very nature be easily captured for computer representation, the domains to which expert systems are applied have continued to grow over the years. This suggests that there are domains in which scholars believe that expert

systems would achieve a degree of success. This does not rule out the existence of domains where they are likely to fail abysmally.

Stuart Dreyfus had also argued in a discussion panel (Davis 1989) that it is more likely that experts use their intuition in reaching judgements than rules. He argues for example that a chess player makes a certain move in a situation simply because he recognizes that situation as one encountered before, and thereby makes a move he considers the best in that situation. As such he suggests that models of knowledge based on neural nets may be better equipped to capture the associational intuitive aspects of human knowledge. Nonetheless, he concedes that an assessment of the effectiveness of rule based expert systems is subject to further experimental analysis. In this regard, the expert system community has claimed a degree of success with respect to the effectiveness of rule based expert systems in the domain of mineral exploration.

In spite of these criticisms, we believe it is worthwhile for researchers in third world countries to begin to explore the potentials of expert systems as a means of codifying and replicating human expertise in different domains. While Dreyfus has argued in (Davis 89) that "in no sense can one capture human expertise and store in the form of a complex reasoning system" on the account human knowledge being an "intuitive associative ability", the degree of success attributed to rule based expert systems suggest that they have potentials in some domains.

In this regard, at the Department of Computer Science, University of Ibadan, Ibadan Nigeria, we have embarked on a long-term project that aims to examine the potential of expert systems as a means of expertise retention. As part of the project we have begun to elicit knowledge from experts in a number of domains. This project is being carried out by three academics and three graduate students.

Our broad objective in carrying out this project is to examine the nature of expertise in the different domains and determine the domains in which rule based systems have potentials of performing almost as well as the experts in reaching decisions. This we intend to achieve by:

- Eliciting knowledge by a careful process that ensures accurate communication between the knowledge engineers and the experts.

- Developing such rule based expert systems have the means to reason about the uncertainty inherent in very many domains.

- Studying these expert systems for how accurately they capture the expert's knowledge by comparing their conclusions on different case studies with those of the expert they replicate. From the 'success rate' of our expert systems, we will determine the potential of success for expert systems in each domain.

Apart from the potentials for expertise retention, this project is important for human resource development because new expert systems can be a tool that supplements the training of new experts. Similarly, by comparing systems developed with rules elicited from experts at different levels of expertise, it is possible to compare the evolution of expertise over time. Evolution may also be studied by repeatedly eliciting expertise from the same expert at different times and marking the difference in conclusions at different times.

In the rest of this paper we present a report on the state of this project. Section 2 discusses a systematic technique for eliciting knowledge from experts in such a way that the quantitative aspect of knowledge is also elicited. This technique forms the bedrock of our knowledge engineering process.

2. Quantitative Knowledge Elicitation

In many domains of human endeavour, an expert is consulted in order to reach a conclusion based on observations that are made in respect of particular case studies. A field that fits such a description is medicine, where a doctor is called upon to diagnose a patient suffering from a set of symptoms e.g. MYCIN [Shortliffe 1976]. Another case in point is a system predicting mineral deposits that may be available on a site given basic observations about the site e.g. Prospector [Gaschnig 1981].

Many fields including those described above involve some kind of causal reasoning. Much of the research in expert systems carried out in the 1980s were done under the assumption that most if not all fields required some kind of causal reasoning [Bond 1981][Charniak and McDermott 1985]. Causal reasoning requires one to reason

about the cause of an observed fact. In diagnosis, for example, one must conclude the disease that is responsible for a particular symptom. However, because an observation may have resulted from a number of possible causes, it is difficult to conclude definitively that an observation resulted from a particular cause. As such one must resort to some kind of probabilistic reasoning in order to capture *causal reasoning* or *abduction* involved.

To reason about such uncertainty, the Bayesian theorem has been used in a number of the early expert systems e.g. Prospector [Gaschnig 1981]. With this kind of reasoning one wishes to determine the probability of some conclusion or cause C being responsible for a set of observations O_1, O_2..O_n. One can denote this as $P(C \mid O_1, O_2, ..O_n)$. The Probability of a conclusion C being responsible for a single observation is given by:

$$P(C \mid O) = P(C) \,.\, P(O \mid C) \,/\, P(O)$$

Where P(C) is the posterior probability of condition C, P(O) is the probability of the observation O while P(O | C) is the probability of the observation O occurring given the condition C. In explaining many independent observations, it is important to find the probability that a particular condition explains all the given observation i.e. $P(C|O_1\&O_2\&..\&O_n)$. This is given by:

$$P(C|O_1\&\, O_2\&..\&O_n) = P(C)\,(P(O_1|\, C)/P(O_1))\,(P(O_2|\, C)/P(O_2))..\,(P(O_n|\, C)/P(O_n))$$

One of the major problems that knowledge engineers face in knowledge elicitation is determining or estimating the probability figures associated with conditions, observations and the chance that some observation is made given some conclusion. All these are needed in determining $P(C|O_1\&O_2, \&...\&O_n)$. In building earlier systems such as Prospectors, domain experts were asked to subjectively give these figures. But over the years we have discovered that a communication gap exists between knowledge engineers and domain experts in eliciting such figures.

An attempt has been made [Akinkunmi and Olamiti 2002] to define a systematic means of eliciting such knowledge from experts. The approach proposed is in three steps involving the following phases:

- *Domain understanding.* In this phase, the knowledge engineer tries to get familiar with the domain. Precisely he tries to understand the observations and the causes about which the proposed expert system is expected to reason.

- *Loose Association.* In this phase an association is established between observations and causes. For each of the causes, the knowledge engineer would elicit from the expert the list of observations that may be present.

- *Quantitative elicitation.* In this phase, the knowledge engineer tries to elicit from the expert the three required probability figures that are required in computing the probability of a cause given an observation. The approach recommended is questionnaire based. The questionnaire is designed such that it contains questions for experts on the following:

  - P(C) : " In what percentage of the cases is cause C the case?"
    - 1 out of 100 cases
    - 1 out of 100 cases
    - 1 out of 1000 cases
    - 1out of 10,000 cases
    - Others, specify.

  - P(O|C) : " In how many confirmed cases of cause C has the O been observed?"
    - Never
    - 1 out of 10 cases
    - 3 out of 10 cases
    - 5 out of 10 cases
    - 7 out of 10 cases
    - All cases
    - Others, Specify.

  - P(O): "How often does one come across the observation O?"

- 1 out of 10 cases
- 3 out of 10 cases
- 5 out of 10 cases
- 8 out of 10 cases
- Always

We note here that while the P(C) and P(O) question is required for each cause and observation respectively, each P(O|C) is required in a case in which an association is not ruled out in phase 2 between cause C and observation O.

3. Progress Report

In this section, we wish to report the progress made particularly in respect of two domains of expertise. These are in the domains of drug reaction and the diagnosis of liver diseases. What we set to achieve in both domains is to successfully elicit knowledge from the more than one expert in each field and to compare their inferences on the same cases. However as it turned out, we have completed the task in the latter field and not in the former. The details are contained below:

3.1 Drug reaction

For this domain, we are interested in assessing the risk that a patient runs in the administration of drugs. We wish to build an expert system, which takes a dossier of a patient's conditions and predict the risk involved in a patient using a certain drug. For the knowledge elicitation we had the support two pharmacists. The knowledge elicitation was done in three phases:

- *Phase I*: We worked with the domain experts in determining the conditions under which a patient may react adversely to drugs. Some of those commonly identified conditions include: *renal impairment*, *pregnancy*, *cardiac disease*, *history of allergy*, *age-brackets* etc. At this point we decided to limit our interest to a small domain of commonly used antibiotics, particularly because the domain of drugs is very wide. The group of antibiotics includes drugs like *penicillin*, *ampicilin*, *ofloxacin* etc.

- *Phase 2*: At this phase we decided with the help of our domain experts the conditions that may be associated with reaction to each drug. For example, conditions that may be associated with reaction to penicillin include *renal impairment* and a *history of allergy*.

- *Phase 3*: This is the most demanding phase of the three requiring us to elicit information that would help our system determine the probability that a certain patient would react to a certain drug. In order to determine this, we need to see from basic probability that it is true that:

$$P(DR \mid C) * P(C) = P(C \mid DR) * P(DR)$$

(where DR refers to reaction to drug D, and C refers to condition)

As such the probability that a patient in the condition C will react to drug D is given by:

$$P(DR \mid C) = (P(C \mid DR) * P(DR))/ P(C)$$

Similarly, the probability that a patient with two conditions C_1 and C_2 will react to a drug D is given by:

$$P(DR \mid C_1 \& C_2) = P(DR)*(P(C_1|DR)/P(C_1)) *(P(C_2 \mid DR)/P(C_2))$$

The objectives of this phase therefore is to determine P(DR) for each drug D, $P(C \mid DR)$ for each appropriate condition C and drug D. This is so because we can derive P(C) from the two quantity by:

$$P(C) = P(C|DR).\ P(C) + P(C|\neg DR).P(\neg DR)$$

where $P(C|\neg DR) = 1 - P(C \mid DR)$ and $P(\neg DR) = 1 - P(DR)$

In order to determine P(DR), we had to ask in our questionnaire, a question like:

What fraction of patients on which chloroquine is administered, register a reaction?

- 1 out of 10
- 1 out of 100
- 1 out of 1000
- Other, specify.....

In order to determine P(C | DR), we ask in our questionnaire, a question like:

What fraction of patients with known reaction to ampicilin, had renal impairment?

- 1 out of 10
- 3 out of 10
- 5 out of 10
- 7 out of 10
- All
- Other, specify.....

We wish to note here that it is natural to expect P(C|DR) to be of a higher order than P(DR), because P(DR) is based on a much bigger population, which is the population of all patients on which drug D is being administered.

However we did not try to elicit P(C) from the expert since we can derive that from P(DR) and P(C | DR) as explained in the last section.

We are in the process of implementing an expert system based on the knowledge thus elicited from the expert. We hope to compare conclusions from the system with actual conclusions of experts on real case studies.

3.2 Diagnosis of liver diseases

The second project is aimed primarily at designing an expert system that would diagnose liver diseases, with a view to estimating the effectiveness of the end product. Also, since the domain is small enough, we wanted to design a system that would encode the knowledge of different experts, with a view to enhancing comparison of conclusions reached when the system uses the knowledge elicited from three different experts.

The knowledge elicitation for the system proceeded in three phases as discussed in the last section and for the drug reaction project in section 3.1. The first phase was conducted mainly using medical textbooks, with little help from the domain experts. Diseases in this domain include: Hepatitis A, B, C, D, E, G, Hemangioma, Biliary Atresia, Carcinoma, Galactosemia etc., while symptoms include Jaundice, Diarrhoea, Coloured stool, Fever, Nausea, Tiredness etc. Some symptoms are gender specific such as menstrual irregularities and male impotence.

The second phase was also conducted using medical textbooks, but was subject to validation of domain experts. This phase had to do with associating diseases with symptoms, so that for each disease, we have a list of associated symptoms. For example associated with *Cirrhosis* are the following symptoms: Menstrual irregularities (for women) Jaundice, Bleeding, Abdominal pain, swelling of abdomen, swelling of ankles, Heart failure, Diabetes, Weight loss, Anorexia. It was not difficult to achieve a consensus among the three domain experts at this phase because much of the derived information came from reputable medical sources.

The third phase of the knowledge elicitation process associated probabilities to each disease P(D) and to the association of each disease D and symptom S, i.e. P(S | D). These were elicited by posing questions similar to those presented in the previous section in the questionnaire. This questionnaire was administered on the three experts: one of which is a consultant and the others general practitioners. We anticipated that there would be a significant different in the outcomes of diagnosis of the consultant and the two general practitioners.

In our implementation of the expert system (done in Java), the system asks some background information from the expert. After this the systems inquires about the attendant symptoms, and then presents the diagnoses based on the knowledge elicited from three different doctors. We tried this out on three actual case studies. In all three cases we found that the diagnoses of the program using the knowledge from the three practitioners (or knowledge

sources) were for all practical purposes the same. The system diagnoses all agreed with the actual diagnoses in the hospital.

In all three cases the two most probable diagnoses were the same. In one case all three knowledge sources diagnosed Hepatitis B with a probability of 1. In another case, Carcinoma was the most probable diagnosis from the three knowledge sources: first general practitioner (GP 1) with a probability of 0.72, second general practitioner (GP 2) with a probability of 0.82, and the consultant (C) with a probability of .9. The second probable diagnosis for all three knowledge sources is Cirrhosis: GP1 with a probability of .63, GP2 with a probability of .8 and C with a probability of .77. Thus in this case, all knowledge sources agree that while Carcinoma is the most probable diagnosis, Cirrhosis cannot be ruled out.

3.3 Problems of Knowledge Engineering practice

Attitude of Experts
Some of the problems we have encountered in carrying out this project over the last four years have been that of securing the confidence of domain experts. Many domain experts (particularly in medicine) have openly expressed fears that the knowledge obtained from them may be misused by our project team. Recently, we have received cooperation from experts in a number of domains. However we discover that much of the support we secured has been from experts who are familiar with similar knowledge engineering projects elsewhere.

In some other cases it has been difficult to secure the cooperation of experts due to very busy schedules. It would really be helpful to conscript domain experts into the project on a part time basis. In this regard it will be helpful to secure some funding.

Confidentiality and difficulty in securing case studies
In order to test the designed expert systems, one needs a substantial number of case studies. While this may be readily available in the field of medicine in the form of case notes, it may not be readily available in fields like Engineering chemistry or even Fish medicine if individual experts do not take time to keep a comprehensive diary of daily professional encounters.

Even in the field of medicine where case notes are available, many hospitals are reluctant to release such them because doing so puts patient confidentiality at risk. We realize that the number of case notes used to test the diagnosis system described in this paper is quite inadequate.

4. Future Directions

We conclude this paper by discussing some of the possible future directions of the work described here.

The Role of Communication in knowledge elicitation
A major communication problem creeps into knowledge elicitation at the point of eliciting the probability values from the expert. The knowledge engineer must understand the notion of the quantity he is trying to elicit from the expert, and must be able to communicate it effectively. The appropriate way to pose a question to the expert in the questionnaire may depend on the domain in question. However, a basic understanding of the basic notion of probability will help the knowledge engineer to ask the right question in the right way..

To illustrate the importance of communication in the task of knowledge elicitation, we consider this example taken from actual questionnaires designed by knowledge engineers. In order to elicit the P(Symptom | Disease) one may ask:

How often does a patient with Hepatitis-A complain of having fever?
- Always
- 7 out of 10...

A more appropriate way of asking the question is:

What fraction of patients diagnosed with Hepatitis-A showed signs of fever?
- Always
- 7 out of 10.....

In the near future we wish to investigate how both the linguistic and technical aspects of communication may affect the outcome of knowledge elicitation.

Validation and Comparison of knowledge sources
A validation technique is available for the elicited knowledge from Bayesian probability theorem. If O is an observation and C is a cause, the following holds:

$$P(O) = P(O|C).\ P(C) + P(O|\neg C).P(\neg C)$$
where $P(O|\neg C) = 1 - P(O|C)$ and $P(\neg C) = 1 - P(C)$

This above equation is used to eliminate P(O) from the original Bayesian equation, and it is called normalization in (Russell and Norvig 1995).

In order to validate, the quantitative aspect of the knowledge source, one needs to verify the above equation from the elicited quantities. As it may turn out in establishments where good records are kept, it may be possible to obtain both P(O) and P(C) from available statistics.

Although this has yet to be done for the elicited knowledge in the domains in which this technique has been applied, it remains a potential way of validating the knowledge sources.

One way of comparing knowledge sources is by testing them on many test cases. However it is important to invent an analytical means of comparing elicited knowledge, because it is possible to test knowledge sources with many test cases without actually exploring certain aspects of their differences, the same way black box testing may not explore certain paths in a computer program.

The potential of data mining
In cases where huge databases are available, data mining may be a more accurate way of deriving knowledge sources from case studies. All of the three quantities involved in the Bayesian formula can be derived from mining large amounts of data of case notes.

The figures arrived at by the process of data mining should be different from location to location in a domain medicine, because the prevalence of diseases vary from place to place at different times.

The problem with mining in the third world is that more often than not, such vast amounts of case studies are hardly kept at all.

- Create a framework for comparing knowledge elicited from different experts, for significant differences in the conclusions reached on different cases. In other words it should be possible to conclude whether or not two experts belong to the same *school of thought*.

- Create a framework for investigating the difference in the expertises of different level experts, as well as a means of monitoring and creating models of growth or evolution of expertise over a period of time in practice on the part of a beginning expert, through information technology.

5. References

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ENDNOTES

[i] O'Connor (2003) describes one recent Australian study that spanned twenty subjects and six universities. This saw 1925 essays being submitted into Turnitin, an electronic detection service that compares electronic work submitted with the 2.6 billion publicly available pages on the internet, and to all the essays previously submitted to Turnitin for checking. This study found that 14% of essays "contained unacceptable levels of unattributed materials." Further, unacceptable levels of plagiarism were found to be present in all six universities and in over 70% of the subjects. The report also highlighted that what was detected electronically is just the tip of the iceberg, as Turnitin did not cover most books, journals and paper mills etc (O'Connor,2003).

[ii] A fingerprint is created by removing spaces and other formatting information so as to first have a continuous string of characters. Following this the characters are then divided into groups of between 5-8 characters depending of the specific software, each character is then turned into an integer (in the example 'howto' becomes '77') through what is called a hash function. The software then selects a sample of these hashes to for a document fingerprint.
[iii] Experiments done by the authors of winnowing (Schleimer et. al. 2003).

[iv] More accurately called "actants" to denote "whatever acts or shifts actions".

[v] See Walsham (1997) for a survey of the use of ANT in IS field.

[vi] DIGITALDIVIDE mailing list (DDN) –http://mailman.edc.org/mailman/listinfo/digitaldivide Telcentres Working Group – http://mailman-new.greennet.org.uk/pipermail/telecentres/
Community Informatics Researcher Network (CIRN) - http://vancouvercommunity.net/lists/arc/ciresearchers
Community Informatics - http://vancouvercommunity.net/lists/arc/communityinformatics
[vii] *PT – Partido dos Trabalhadores*

[viii] The RITS (*Rede de Informações para o Terceiro Setor* – Network Information for Third Sector) is an organisation from the third sector, without profit finalities, that aids the E-Citizenship Project.

[ix] Sampa.org supported the creation an information service which affords to provide regular news and an alternative view about this region that is usually not taken into account by mainstream media (usually focused on violence and drug traffic).
[x] This is a partnership between a local NGO (*Sociedade Santos Mártires*) and a software company (*Mitsca*). This project intends to make available in digital form a large multi-sector database of the district as a central resource to local human development.
[xi] The municipality budget is defined a year before. At that moment, the new government had took over and the budget was define by the previous mayor. Consequently, it did not anticipate expenses for this kind of project since the previous local government had not digital inclusion project.
[xii] According to an E-mail correspondence with Mayuri Odedra-Straube of the Working Group 9.4 between the 15th - 17th of September 2003.
[xiii] See Geertz 1983.

[xiv] See Hodge/Kress 1988.

[xv] See Witzel 1985.

[xvi] For "developing countries" there is a degree of self-selection and no definition. Currently all least developed countries have declared themselves as DCs. http://www.wto.org/english/tratop_e/devel_e/d1who_e.htm

[xvii] According to the definition of UNCTAD from 1971. http://esa.un.org/unpp/definition.html

[xviii] This study will be the basis of the dissertation of Raphael Schneeberger.
[xix] After his return in October 2002 the author who did the research work in Africa wrote down his experiences as unsystematic research notes in a narrative and expressive way.
[xx] Power in the meaning of a relation (which is more or less balanced) and not something stable that automatically goes along with specific characteristics. Power is negotiated in discourses the way cultures or social relationships are: by representation. The design of power can also be observed in such text as transcribed interviews are.
[xxi] The same proceeding can be found in almost all other interviews.

[xxii] This difference was also pointed out in some interviews led with the permanent staff.

[xxiii] Informant: "So, I just go there for the sake of it, because you have said it."

[xxiv] This implies that the children are expecting the teachers to control the technology:

Informant: So, like when you make a mistake (.) it becomes difficult for them to remove it, but, well, for you, you know, hopefully (*???*), where to go, what what.

Interviewer: Mhm.

Informant : Some teachers it's a problem. (..)

[xxv] See Steinhardt (1994) for details how the Austrian youth approaches to new technology.

[xxvi] Several of the pupils have a computer at home.

[xxvii] in the meaning of instructors with a different cultural background

[xxviii] AOSIS includes some islands and low-lying coastal areas which may have populations greater than 1.5 million but share similar characteristics to SIDS, such as Papua New Guinea and Guyana.

[xxix] Riots have only occurred three times in the country - 1965, 1968 and 1999 (Dommen & Dommen, 1999).

[xxx] SHOCKING stood for Standards and Practices (developing a set of standards in the civil service); Human Resources (to achieve a five-fold increase in the IT professional pool within seven years and to set critical IT skill development centres); Organization Incentives (to offer incentives to SMEs); Key Drivers (to develop inter-sector and intra-sector IT and to establish a software park) and Global Vision.

[xxxi] The District Health Information System (DHIS) is the open source software of the Health Information System Project (HISP).

[xxxii] PHC refers both to 'primary health centre' and to 'primary health care'.

[xxxiii] In late 2003, HISP-India was commissioned to extend the district health information system (district database) throughout Andhra Pradesh, a radical change in scale and complexity as the State of Andhra Pradesh has a population of 75 million.

[xxxiv] Mandals are small revenue and administrative divisions in a district.

[xxxv] HISP is a global network aimed at creating a sustainable health information system that enables health workers to manage their own health information at local levels and support decisions based on information to improve health care delivery. (http://hisp.org/) The Karnataka project was a collaborative process between the University of Oslo and the Indian Institute of Management, Bangalore.

[xxxvi] This inertia can also facilitate institutionalization of Prasad's appointment, since equally elaborate procedures will have to be followed to reverse it . With the frequent transfers at managerial levels, it is likely that the process of his elevation to the taluk will become a historically accomplished fact.

[xxxvii] The case study taluk was close to the state capital. Such postings are seen as desirable and many of the health workers in such postings were able to stay in their places by their political connections. This could also mean that under performance was not perceived as a threat by them.