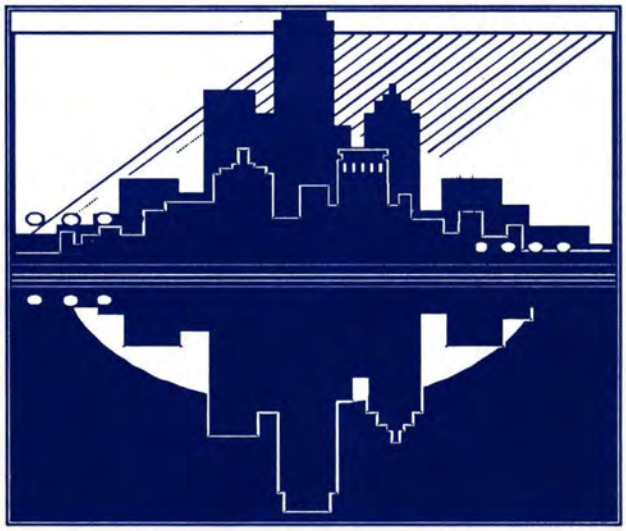
GLOBAL INFORMATION TECHNOLOGY AND SOCIO-ECONOMIC DEVELOPMENT

Edited by

MAYURI ODEDRA-STRAUB



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Preface

The potential of information technology (IT) in improving public administration and increasing industrial competitiveness is recognised but its widespread use is still a distant goal. Since developing countries (DCs) are making increasing investments in IT, there is a need to understand the factors that will promote its effective utilisation. There is very little by way of a body of knowledge or documented practice which can guide trainers, educators and practitioners in planning and implementing IT projects.

With this in mind, an international conference, titled **Information Technology and Socio-Economic Development: Challenges and Opportunities**, was held in Cairo, Egypt, from January 9-11, 1995. The aim was to bring together and critically examine experiences from a number of DCs, who have much to learn from each other's experiences. The conference was organised by the International Federation for Information Processing (IFIP) Working Group 9.4 on "Social Implication of Computers in Developing Countries", Information and Decision Support Centre (IDSC) and Regional Information Technology and Software Engineering Centre (RITSEC), both based in Cairo. The conference was attended by over 300 people from around 20 nations.

Papers were invited in the following areas: role of IT in creating a culture of free access to information in DCs; social impact of IT; potential of IT in improving public administration; role of IT in enhancing competitive advantage; managing ITs in DCs; international trade and technology transfer: need for a fair play between North/South; upgrading infrastructure to exploit full potential of IT; and role of emerging ITs in DCs. Over 60 papers were submitted to the conference for consideration of which 34 papers (all reviewed by at least three referees) were accepted. Of these, only 25 authors managed to attend the conference to present their papers. In this proceedings, only 23 selected papers are published.

As there is an overlap of issues being discussed in the papers - some papers discussing a number of general issues whilst others, such as the case studies, are also addressing systems development issues, for instance - it has been difficult to categorise papers under different sections in this book, although an attempt is made to group papers addressing similar issues.

The quality of work presented at the IFIP WG9.4 conferences - as far as contents are concerned - has improved over the past few years (there is more variety in the issues being discussed, addressed and researched) but there is still scope for major improvement. The quality - in terms of originality of ideas, new research, references, writing style, the issues being addressed, etc. - is still largely disappointing (though improving) and problems are often encountered in attracting good papers from DC authors. The reasons for the papers not being of "high quality" are many and include issues such as an author's lack of access to secondary literature or reference material, lack of writing practice, and lack of research in many DCs. Such weaknesses are apparent in some of the papers accepted for this proceedings; the selection of papers was based on the originality of ideas and issues rather than anything else.

Over a span of three days, a number of issues such as the need for policies and planning, infrastructure, human resource development, systems development, role of governments, management of change, maximising the use of information, globalisation vs. liberalisation, domestic markets vs. exports, development, technology and sustainability, and transferability of technology and methods, were discussed. A number of case studies, examples of application of IT, and opportunities offered by the technology, were used to illustrate these issues.

I would like to take this opportunity to thank the Egyptian hosts, namely IDSC and RITSEC, as well as all others who sponsored this event, and made it possible for a few participants from DCs to attend the conference. My special thanks go to all the local (Egyptian) sponsors, IFIP and Commonwealth Secretariat for their continuous support at such events.

I would also like to thank all those referees who helped review papers for this conference. My special thanks go to Rekha Jain, Chrisanthi Avgerou, Shirin Madon, C.J. Meadows, Richard Heeks, Ed Roche, Jonathan Liebenau, Syed Shah, Frank Land, Barbara Farby, Tim Waema, and Subhash Bhatnagar for all the time they spent in doing a thorough job reading and commenting on the papers. Last but not least, I would like to thank my husband Bernhard for his understanding and patience in the past two years.

Mayuri Odedra-Straub

Introduction

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The application of information technology (IT) has grown tremendously in the past two decades worldwide and its importance - as a tool for socio-economic development - is greatly emphasised in developing countries (DCs). The advantages of using IT are well known. IT can deliver competitive advantage in terms of better quality products, enhanced control, reduced costs, increased flexibility, and so on. IT can increase efficiency and effectiveness, and strengthen management and administrative functions, and is now virtually essential for commercial success and even survival. IT has rapidly become the infrastructure upon which business is conducted and has penetrated all sectors of our economies and well being. While previously IT catered for few - and was served by many - this is now changing, thanks to ever cheaper and more versatile applications.

Overall, IT has the ability to help with the socio-economic development of a nation. It has the power to narrow the gap between the advanced industrial nations and those developing, the capabilities which could allow the DCs to leapfrog development, and the potential to help tackle many social and economic problems. This, together with other reasons, has led to an increase in the number of computers and sophisticated telecommunications equipment in all sectors of the developing economies.

However, while the use of IT has assumed increasing significance in DCs, the operational effectiveness in many IT applications has been far below initial expectations, if not disappointing; there are few success stories to talk about. The overall impact of IT on DCs has been low, the penetration of computers in these economies is poor, and experiences in the use of IT have been mixed and often disillusioning. Moreover, the potential role which many saw - in the application of IT for the socio-economic development of a nation - has not been fulfilled. This is because many of the IT applications have not been successfully applied; successful implementation of IT projects has higher chances of contributing towards economic development. Neither has the technology been applied to sectors which influence the majority of the populations in DCs.

While the most frequently quoted problem for the diffusion of IT in DCs is lack of financial resources to acquire and maintain the technology, the most important fundamental problem is lack of skills to develop and operate new technology based systems, as well as a lack of organisational capacity to accommodate and make effective use of the technology. The poor choice of applications and unsuccessful implementation in several countries is also a result of lack of trained information analysts who can identify, design and implement applications which will impact the key performance areas of an organisation. A lack of IT awareness amongst managers and narrow technical skills in IT professionals have also prevented them from coming together to identify and implement meaningful IT applications. Applications that would improve utilisation of capital equipment or increase the efficiency of logistic systems have not been developed. Fear of unemployment has also made it difficult for large public sector organisations to implement transaction processing systems in areas where they are most needed, such as the public sector utilities (water, electricity, telecommunications, etc.).

Overall, the policies influencing the introduction of IT have not been in co-ordination with other efforts such as the development of adequate supporting infrastructures, and education and training for users. With a few exceptions, DCs have not been actively involved in the development and diffusion of IT, and their capacity to monitor, adapt and redesign them has remained weak. The lack of trained people capable of assessing and translating relevant information into operational decisions, and capable of learning from such experience, has been by far the most important missing link.

Moving on to the papers in this proceedings, we notice that many of these observations are also highlighted in Waema's paper which draws on experiences from Kenya. Some of the reasons he sights for the unsuccessful application of IT in African DCs are: lack of skilled IT personnel; IT spending misdirected and inefficiently used;

acquisition based on poor or non-existent user requirements; lack of national IT policies; lack of organisational strategies; unsupportive public sector culture; inadequate infrastructures; lack of planning; inability to manage change; human malpractices; etc. He suggests a number of strategies to improve the situation, such as the government creating an enabling environment for IT use by formulating IT policies, liberalising other policies, improving infrastructures and increasing their use of IT. He also places emphasis on project leadership, empowerment of the users, improvement of education and training, and experimenting, piloting and learning from experiences.

Oyomno's paper is more specific in a sense that it is a summary of a study he conducted in a number of ministries in Kenya to examine the rapid expansion of microcomputer use in the government. What he observed was that there was a high demand for such technology in the government, that the technology was appropriate, and that the existing local technological capacity in Kenya was insufficient to sustain beneficial use of the technology without external support. This lack of local technological capacity supports claims made earlier by Waema and the author as a possible cause for unsuccessful application of IT in DCs. Oyomno writes that there has been a significant improvement in the quality of management decisions and consequently the overall performance of these organisations with the introduction of microcomputers. However, the introduction and continued use of the technology in these organisations is supported by funds and technical assistance from donor agencies which raises some questions about the long term sustainability of the projects. Moreover, the projects have primarily focused their activities on the development and delivery of specific outputs in terms of information systems within specified limited time frames. This, as well as other reasons, has meant that little or no provision is made to build the technological capacity of the recipient organisation to sustain beneficial use of the technology beyond the life of the project. Few efforts have been made to facilitate effective transfer of relevant technology and user skills, expertise and experience. This has created dependency on external or expatriate staff and has often resulted in continuous renewals of project contracts. This raises the issue of whether sustainable use of the technology in the government can **ever** be attained without dependency on external assistance. The reason for emphasising the ever is that the author's own work in the same area a number of years ago also revealed the over-dependence of government ministries on external or expatriate staff and Oyomno's study shows that the situation has not improved over the years (see Odedra, 1990 and 1994).

Lind's study of a number of organisations in DCs shows that computers are still used for simple applications such as basic accounting and invoicing and that their potential as instruments for analysis are very often unexploited. This may be due to the managers lack of experience in using information for decision making, their resistance to depending on information for decision making, their lack of analytic skills (which existing analysis tools take for granted), or due to the inappropriateness of some of the applications to the DC context. This highlights the point that applications developed in the West may not be suitable for a very different DC culture and socio-economic context, and calls for the need to develop applications more suitable for the DC circumstances. The existing lack of correspondence between reality and model hampers the use of IT for certain types of analysis. The situation could be improved if there was more creativity in the development of new application areas such as simple business analysis.

The next few papers examine the application of IT in particular settings. Madon and Sahay examine the status of Geographical Information Systems (GIS) in India and, based on their previous experiences in district level computerisation, make some suggestions as to how GIS should be introduced in district administration. They argue that investment in GIS presents economic and organisational risks, apart from benefits, and therefore should be planned thoroughly. They make a number of recommendations to authorities contemplating the introduction of GIS for development planning and place emphasis on a number of issues which should receive attention, namely institutional reforms, technology transitions, human resource development and technical support.

Getao and Odhiambo examine ways researchers could use computers to address the AIDS crisis in Kenya. Difficulties are currently encountered in collecting and providing data and information about HIV positive patients, largely because of the social implications involved. They suggest ways in which computers can help preserve donor anonymity and identify a statistical technique which enables more accurate and efficient screening for AIDS while preserving anonymity. Their case is an interesting example of an area in which IT could be beneficially used to address such issues in developing countries.

Grobler also examines ways in which computer technology, as a facilitator, could be used to improve the existing education situation in South Africa. She describes two projects where the benefits occurring from computer

supported cooperative education and learning are explored. Although the two cases show positive results they are not detailed enough, are undertaken in a "laboratory environment" and the samples used are too small. Their large scale success can therefore not be justified on these basis alone. Moreover, such an application of computer technology may be hailed as a more efficient and effective learning process, which can open up a world of learning to the users and "set them free on the road to inner development", but can such a method be used at a mass level to address the education crisis in South Africa or elsewhere? Will it be accessible to the poor or the rural? Moreover, can technology alone be used to remove the education backlog in that country?

Kiiru examines the challenges posed by the potential use of modern IT (computers and telecommunications), vs. traditional IT (written text, audio, video, etc.), to preserve and access oral literature in Kenya. He discusses the pros and cons of the different technologies available in terms of durability, cost, ability to portray everything, availability and accessibility, users' level of literacy, etc. and argues that although modern IT has a lot of potential to preserve oral literature it is not a technology which can be easily accessible to/by the masses.

Kiangi and Tjipanganjara's paper examines the nature of information flow in a typical DC (with special reference to Namabia), using surveys and interviews, and discusses how IT can be used to facilitate the analysis and dissemination of this information to enhance socio-economic development. The authors highlight some of the factors which have led to poor IT utilisation in DCs, similar to those emphasised by Waema and others earlier, namely that of lack of IT policies to enhance acquisition, haphazard acquisition of hardware and software, limited technical know-how, etc. They argue that by carefully measuring the status and planning IT issues, DCs can also reap the benefits of the technology. They recommend selective investments in areas with a multiplier effect, investments in email and Internet services, strengthening the information resources and flows between the different levels in an organisation, establishing centres of excellence in IT, electronic information bureaux (for unemployed and day labourers), IT policies, etc. Although many others have recommended such measures before, there have been few efforts made by the governments, or others, in the DCs at establishing or implementing any of them and this raises a number of questions about their need.

O'Flaherty and Cooney examine the use of IT and the structural changes undergone, moving from a centralised organisation to one which is decentralised, regionalised and localised, by the department of Social Welfare in Ireland. The interpretive study looks at the social interplay between personnel and the information systems, exploring the structural impacts of the new information systems dealing with issues such as structural centralisation/decentralisation, decision making authority, managerial control, formalisation, task description, hierarchy, and power and politics. The study shows that computers have been an enabling force in the strategic restructuring of the organisation and have facilitated greater efficiency and dramatically increased the services provided. Managers have been freed from repetitive support tasks and can spend more time on conceptual and decision making tasks. There is also more specialisation of tasks and an increase in employment productivity. Although there is more decentralisation of applications development, computers have reinforced the centralised hierarchy and command. With regionalisation there has been further reinforcing of the upward referral of issues through the hierarchy, isolating operational staff to an even greater extent and distancing them further from the strategic apex.

Bhatnagar's paper traces the history of Grameen Bank, a bank providing credit to the very poor in rural Bangladesh, its current use of IT and the dilemmas it faces in further introduction of computers at branch level. Although there is an urgent need to introduce computers at branch offices (currently computers only exist at the head office) and management is keen on promoting greater use of IT, the organisational culture, cost/benefits from computer use, and assessment of risks in developing an application portfolio for the Bank hinders further introduction of the technology. Introduction of computers at branch level would improve efficiency, allow more analysis to be done on existing data - results which could be used by researchers, the government to plan and formulate policies, by international development organisations, etc. -, reduce the cost of a large volume of transactions, release staff to do more field work, help produce MIS reports early, and help generate accounting statements faster and more accurately. However, these benefits are strongly counteracted by negative consequences and other issues which make it difficult to introduce computers and justify their need. For instance, the cost of introducing a computer in a branch is five times the operating profit per branch. If some staff are reduced the cost of a computer can be met but how does one justify this? Moreover, the introduction of computers could have severe consequences on the organisational culture and its position amongst the very poor in the country. The poor

telecommunications infrastructure in Bangladesh would not allow networking in some rural areas and this raises the question of the need to introduce computers in branches which cannot be linked. The above case is a typical example of many organisations in DCs which desperately need to introduce IT but which are hindered from doing so by circumstances as those outlined in this case.

The next few papers address issues involved in systems development. Avgerou's paper argues that organisations in DCs should be cautious when they adapt systems development methods and try to introduce organisational change by means of implementing IT based information systems. She goes on to argue that transfer of techniques, methods, models and organisational practices may impede rather than facilitate the utilisation of the potential of ITs in DCs. In other words, practices that have proved valid in one context cannot be transferred and successfully applied to a completely different context. She feels organisations in DCs should learn from western theoretical efforts rather than transfer practices packaged in the form of methods or organisational change recipes. That DCs need to learn ways that can serve their own needs rather then copy IT efforts made in the industrialised countries. Her arguments are demonstrated by a case study of an organisation from a Latin American country.

Korpela also looks at systems development but in the context of health informatics/information systems in Nigeria. His paper is aimed at providing a broad theoretical framework (linking together supra-societal, societal, organisational and work activity levels of analysis) for studying the work practice of Nigerian systems developers, as an endogenous process which may generate relevant experiences for systems developers everywhere. He assumes that in Africa the context of information systems development and use is much more demanding than in the industrialised countries and therefore by studying the practice of the systems development work in Africa, one can learn something. He makes a number of conclusions from his project: (1) a multidisciplinary approach is necessary in understanding information systems development in a given society and that social sciences are particularly important here; (2) DCs need information systems development methods that will cost-effectively address the basic needs of the people and as a by-product generate a sustained endogenous network of supporting activities; (3) methods of analysis and values which pay attention to the social purpose of work and information systems are needed as existing theory has not gone very far in analyzing the different power bases of the different stakeholder groups of information systems development, nor in finding ways of empowering the people who are the social carriers of priority needs; and (4) the important relevance of information systems sciences should be realised.

Braa's paper also looks at systems development and health information systems. He presents two case studies, from Mongolia and South Africa, concerning decentralisation of health service management. He observes that the major obstacles in the reformation of health systems in both countries are the resistance to change by the strongly centralised structures and the bias towards curative medicine - rather than preventive care which both governments are trying to introduce - inherent in the present health system. The author recommends some methodological approaches to overcome some of these obstacles and suggests evolutionary and participatory approaches to information systems development; a process of continuous learning in order to modify and improve both the information system and the management systems. He tries to link the concept of community participation with the concepts of participatory design from the discipline of systems development. He argues that a decentralised and democratic biased "bottom up" approach to health systems and health information systems will require local initiatives and enthusiasm, which in turn emphasises the necessity of empowering communities and allowing them to participate in the development of the health system. Braa feels that such participatory approaches to system development might be important both in defining the needs and in making the health information systems address these needs. However considering the scope and scale of the health sector in a country, it is difficult to imagine such a participatory approach to systems development involving a 'reasonable proportion' of the community. Experiences from the two cases also showed that local decision making must be coordinated with a process of organisational change and that the development of information systems must be integrated with the development of new managerial structures.

Volkow also addresses the issues involved in systems development and traces the history of a Mexican oil company's path to develop an institutional database for planning and evaluation. The organisation and the development of the database was heavily influenced by the political situation in the country and the changes required to the system by (frequent) new administrations. Within the organisation, the development of the database was also seen as a political process and permanent negotiations had to be made to validate the data. The company's strong organisational culture in which the source of power has been the control over information also influenced the

development of the database. The latter did not imply changes in the organisation but it provided the means to challenge it. However, at the end the database did provoke an organisation change, not directly by its development, but in the implications of its use. Despite the circumstances, the information systems manager did succeed in developing an adequate and efficient system within its context. Volkow argues that the existing methodologies for developing systems, even those that consider participative approaches, do not address the limits that a specific reality poses (such as those faced by the oil company) to the development of systems and ways to solve them. This contradicts some of Braa's views about participative methodologies.

In their paper, Bell and Li set out their experiences, in planning for and, developing a management information system for an institute in China. To develop the system, action research and the Multiview systems analysis and design methodology were used. Action research provided local staff with the opportunity to take part in systems design and to feel a true sense of ownership of the final system whilst Multiview appeared to provide a degree of flexibility in inspecting the information system from the viewpoints of both technical and social preferences. The authors argue that the failure of information systems in many contexts are more likely to be due to the absence of a culture of sustainable information systems development based upon a participative review of the business needs of the organisation, something which they focused on. They feel a technology linked to training and team participation can come together to provide a mix for sustainable systems development. Again, participation is preached and should be practised, as argued by the authors, but it raises a number of issues when the organisation or the system to be developed are 'large'. Who should participate and at what level? Is it really feasible, for instance in the case of the South African health system?

Lai's paper also looks at the issue of systems development and describes an in-depth case study of the development of an information system for a procurement office in the Philippines. She uses two disciplines to develop a framework for her research: systems enquiry through the use of Checkland's Soft Systems Methodology and data analysis through the use of Martin's Strategic Data Planning Methodologies. She argues that the selection of a methodology for systems development should be based on practical application rather than ideological identification, and that independent methodologies can co-exist (as shown by her case) in a broader setting which offers more choices to systems professionals. In other words, IT projects are too complicated to be tackled by a single methodology and it is therefore desirable to merge and rearrange the best features of different methodologies in a wider framework which can address effectively various issues involved in the implementation of IT projects. Since the adoption of IT is an on-going process, she highlights the need for a multi-perspective epistemology which encapsulates an operation methodology to perform systems development work, and a meta framework to make sense of the activities.

Macias-Chapula's paper also addresses the issue of systems development and, like Korpela and Braa, looks at health information systems. The paper presents the results of systems analysis work carried out on Mexico's national health information system. Like Lai, he also uses Checkland's Soft Systems Methodology to analyze his case study. He uses it to identify the different "soft" elements involved in the "problem situation" - which was perceived regarding the overall functioning of the information system. With the identification of those elements, a model and a "rich picture" were obtained so as to propose a "plan of action" to understand and improve the existing situation. The author argues that the use of Soft Systems Methodology to tackle information problems and to analyze information systems in the health sciences provides not only the opportunity to work with a multidisciplinary approach but also favours to cover the gap that exists between the hard and soft sciences. And that if information systems are to succeed, an equilibrium of both hard and soft approaches to their development need to be taken into consideration.

The next few papers address the issue of IT policies in DCs. Olivier's paper addresses some general issues to do with IT policies - the need for a national IT policy, the benefits of having one, what it should consist of and address, the ways in which IT could be incorporated in the development and upliftment of people, the role IT can play in the reconstruction and development program of South Africa, and so on. He feels that an IT policy is required as a foundation whereby the great potential of IT can be realised, development be promoted, technology be fully exploited, and communication problems be alleviated. He argues that people must be the focus point in the incorporation of IT in the diversified societies of DCs, and that the government should play a major role as an enabler and facilitator of IT. Like Olivier, many others have argued for the need of national IT policies in DCs but the preaching seems to have fallen to deaf ears as few governments have made efforts to formulate policies to date.

Harindranath and Liebenau do a fine job in tracing the history of India's IT industry and examine the role played by the government in its development, by the policies it formulated and implemented. The paper illustrates the significance of pragmatic policies for DCs to maximise the benefits from IT. India's earlier protectionist policies of the nineteen seventies gave way to liberalisation and globalisation in the nineties. The paper analyses important changes that are taking place in the Indian IT industry as a result of liberalisation of state policy and the accompanying process of globalisation. The protectionist policy regime had ensured a competitive advantage for hardware manufacturers in the domestic market but with globalisation the advantage has shifted to software exporters and systems integrators. The authors argue that although globalisation has provided a pathway to technological upgrading in India, it is also threatening the survival of indigenous IT firms and their technical capabilities. In other words, liberalisation and the ready availability of foreign technology may lead to a gradual waning of local skills developed during the protectionist days. Moreover, in its drive towards software exports, the Indian government has failed to create and sustain a large domestic market for software and IT applications, which could have provided the industry with immense opportunities for experimenting and learning and in turn with the export efforts. The authors feel the Indian IT industry's future can only be secured by (1) a renewed policy thrust on application development for the domestic market accompanied by a push for IT diffusion, as against mere production, and (2) making crucial inputs available to local firms at very low customs tariffs so that they may be encouraged to continue investing in systems design and manufacturing. They also argue that in the absence of an IT and telecommunications infrastructure, and a culture of IT use in government and business, there is a very real danger of the domestic industry succumbing to increasing international competition from MNCs and other industrialising economies. Some of the other problems faced by the Indian IT industry are: lack of a brand image for its products, small firms' lack of record or history of projects behind them, inadequate marketing resources, brain drain, poor telecommunications infrastructure, and paucity of cheap finance.

Meadows continues with the theme of India and policies but with more focus on its software industry, which she compares with that of the Philippines. She looks at the status of the software industry in the two countries, compares their capabilities and uses Yourdon's four "Stages of Development" to understand the countries software development histories. Both countries have clearly shown that emerging economies do have some software development capabilities and that the resulting technology can be exported successfully to industrialised nations. She identifies Indian exports as consisting largely of "body shop" services whereas most of the Filipino exports have been telecommuted software and packages. She highlights India's strengths as: having a highly qualified price-competitive manpower, improving telecommunications infrastructure, government support for export and foreign investment, lacking mainframe conceptual baggage, having existing partnerships with MNCs and manufacturing presence of major firms. However, India's weaknesses are: piracy, shortage of international marketing capabilities, deplorable current state of telecommunications, shortage of educators, small size of firms, and cross-cultural business problems. Other bottlenecks for the future could be unavailability of adequate manpower and communications links, procedural inertia that dampens entrepreneurial spirit and shortage of training institutes that provide skills relevant for the marketplace. The strengths she identifies for the Philippines are: well educated price-competitive labour force, English proficiency, reasonable international telecommunications infrastructure, some level of government support, less regulation, multicultural paradigms, and strong entrepreneurships. The weaknesses as: capital scarcity, small scale nature of its entrepreneurship, bad international image of the nation, small domestic market, weak IPR, no track record, poor education and training facilities, lack of cooperation between business and the government, fragmented industry, and inadequate marketing capabilities. Just like the previous two authors, Meadows argues that a domestic market is necessary as the development ground for more complex packages and more value added work. The challenges both countries now face are how to: attract international firms, build up their trust, market their capabilities and continue defending their market position.

Roode and du Plooy's paper analyses, from a Third World perspective, the Bill of Rights for the Information Age proposed by Glostonbury and LaMendola. The earlier part of the paper examines the impact of IT on society and organisations. The authors suggest the addition of a number of clauses to the Bill to make it more useful and appropriate to DCs. These clauses refer to the need for: developed countries to assist DCs in establishing ethical checks and balances on their IT industry; information sharing and access between different nations; appropriate transfer of technology; designing ITs in DCs so that there is a "good fit" between the technology and culture; driving the introduction of IT in DCs to satisfy fundamental human needs; training and experience

opportunities to be available and accessible to all workers; IT not to be promoted as a panacea for all problems faced by organisations and societies; applying IT on the tenet that economic and socio-economic development go hand in hand; and appropriate national IT policies. Although many of these issues do address the needs of DCs and should be addressed at an international level, such as in the form of this Bill, it is difficult to see many of them taking effect in the foreseeable future.

La Rovere's paper also looks at policies but concentrates on the telecommunications infrastructure in Brazil. She examines the current state of the telecommunications sector and identifies a number of constraints to IT diffusion in Brazil. The constraints being: inadequate telecommunications infrastructure, lack of resources for investment, high cost of transmission channels, high cost of equipment, inadequate technical assistance, and lack of organisational culture. She argues for the need to upgrade Brazil's telecommunications infrastructure to meet the increasing demands from IT users; something which can only be possible with interaction between the public and private sectors, defined by an IT diffusion policy. She calls for reforms to the provision of the telecommunications services and to state telecommunications companies, and suggests that the national telecommunications companies should look for alternative ways to provide access to information to the poor; that standards should be defined so that fragmentation of networks is reduced; that training inside firms should be enhanced and sharing of experiences between firms supported so that lack of organisational culture and poor technical assistance cease to be a problem; that there should be more focus on small firms; and that IT diffusion should be extended to social areas like health and education.

So far, IT - despite its potential - has played a minor role in changing, for the better, the life of most of mankind in the developing world. The rapid diffusion of IT in DCs has not been accompanied by substantial developmental benefits. Effort therefore needs to be directed at finding out where one has gone wrong in applying this technology. Where do the problems really lie and what can be done about them. The papers examined above, and which follow, highlight and raise a number of important issues which require attention; issues to do with IT policies, systems and application development, methods and methodologies, human resource development, to automate or not to, organisational and cultural factors, the appropriateness of applications or packages developed in a different culture, value of information, and so on.

To discard the technology as a tool of development, owing to its scarce achievements elsewhere, would however be a serious mistake. There is no question as to whether IT is appropriate for DCs or not; it is a technology which cannot be ignored. IT use, if planned and developed properly, can bring about greater efficiency in organisational operations, better working conditions, and faster decision making processes. It should be deliberately incorporated into areas where it increases the efficiency with which governments and other organisations deliver services. The DCs, however, need to learn - by themselves - ways in which IT can be applied to serve their own needs best. The hardware can be transferred from abroad but the best ways to apply it - for socio-economic development - cannot due to the different socio-cultural environments.

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Implementation of information technology projects and economic development: Issues, problems and strategies

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Abstract
Many developing nations are increasingly embracing information technology (IT)[1] as an instrument for increased economic development. This trend is being occasioned and catapulted by the pervasive role and impact of information technology across economic sectors and the marketing of IT products and services. Experience, however, has often demonstrated that quite a large number of IT projects in developing contexts have failed to deliver much anticipated economic development. Often, much IT spending is misdirected and inefficiently used. This experience is based on information systems applications in the urban context but the author believes the situation is even worse in rural context applications of IT. There is thus a need to re-examine where we might have gone wrong and how we could better exploit information systems to foster economic development. This paper reviews, from the author's experience, issues and problems that have plagued implementation of IT projects in developing economy contexts with regard to its inability to deliver economic benefits. It also provides some strategies for implementation of IT projects to deliver economic benefits. Both the issues and problems and strategies have been examined from a framework that recognizes three levels of economic development: national, organizational or community, and individual or group levels.

1. IT and economic development: an introduction

Many developing nations are increasingly embracing information technology as an instrument for increased economic development. This trend is being occasioned and catapulted by the pervasive role and impact of IT across economic sectors and the marketing of information technology products and services. IT has been used to achieve cost savings through increased efficiency of operations and effectiveness, to strengthen management and administrative functions, to improve market performance and to gain competitive advantage. It may have a more critical role now that many developing economies are facing severe economic challenges and changes, particularly as they increasingly embrace market-oriented economic policies where information and information technology are important agents for change. For example, information technology can facilitate economic development through availing information to make choice of development priorities easier and to plan and manage development activities better.

It can be argued that the real tests of economic development is whether it reaches people and whether it is sustainable. Reaching people has the implication that there has to be human development. The basic objective of human development is to enlarge the range of people's choices and make development more participatory and democratic (Human Development Report, 1991). If we are to achieve human development, we must put people at the centre of the development process. We must also ensure that this development is sustainable and thus the second test of economic development. The United Nations Development Programme (UNDP) combines these two tests of economic development in a concept of sustainable human development. UNDP defines this concept as development of the people, for the people and by the people.

Development of the people means investing in human capabilities so that the people can work productively

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1. Information technology in this paper refers to the computer-based technology used for acquisition, processing and dissemination of information, and includes computers, telecommunication and digital electronic technologies.

Development of the people means investing in human capabilities so that the people can work productively and creatively. This may be accomplished through education, training, appropriate reward, and so on. In this way, people will be able to contribute to and benefit from economic development. Experience shows that many economically developing countries, with the exception of a few, such as some countries in East Asia, have not invested in development of human capacity in the information technology area. This inability to build human capability inadvertently thwarts the chances of IT manpower contributing to economic growth.

It can be argued that human development requires economic growth, without which no sustainable improvement in human well-being is possible. Thus development for the people relates to ensuring that benefits of economic development are distributed widely and equitably. It is not disputable that the potential of IT in contributing to capital formation, and thus to economic development, is enormous. For example, with large pools of inexpensive trained manpower, export of IT products (e.g. software) and services (e.g. off-shore data processing or entry) has been done by a number of economically developing countries. Despite this potential of information technology to contribute to economic development, translating economic development into human development is often rather problematic. Thus, high economic growth does not automatically translate itself into high levels of human development. In order for economic growth to translate itself into human development, it is necessary, but not sufficient, for example, to have democratic structures and the political will to facilitate this translation. In most countries, the structures for equitable distribution of economic wealth are either non-existent or have been grossly abused.

Development by the people means giving people opportunities to participate in and contribute to development planning and implementation. Again, this is an area where many countries have failed, partly because of an autocratic national ethic that is found in all areas of most countries' development activities. In the IT area, planning and implementation of information technology has largely been characterised by some form of elitism whereby the beneficiaries are often not involved. In other words, the beneficiaries have been taken to be passive recipients, resulting in their further marginalization with regard to their having the requisite skills and experience to effectively own IT investments. This factor alone has had significant contribution to lack of long-term sustainability of many information technology project implementations.

The points made above clearly indicate that implementation of information technology contributes very little to sustainable human development in most countries. A few examples will serve to strengthen this point. For example, acquisition of many IT products and services has been based on poor or non-existent user requirements, thereby increasing a likelihood of implementation failure and a concomitant waste of investment. Further, there are numerous problems that prevent organisations from harnessing the full potential benefits of information technology. Examples of such problems include a lack of IT policy, of trained professional manpower and of strategic orientation. Finally, much of the IT implemented in economically developing countries does not integrate well into the mainstream domestic economy, and thus ends up being very elitist in its application. Therefore this technology does not contribute significantly to the sectors that impact the majority and, by implication, benefit the majority of the citizenry.

The above scenario is worsened by the fact that in most countries the government and the public sector account for most of the sectors (such as water, health, telecommunications, energy, agriculture, and information and broadcasting) that have direct developmental impact on the majority of the people and investment in IT has been insignificant. Therefore, if IT is to contribute towards economic development in developing countries, then more attention has to be paid to computerisation of sectors controlled by the government and the public sector which could typically account for 75 per cent of the total IT market in a typical developing economy such as Kenya. However, experience shows that computerisation of government functions and the public sector is challenging and beset with numerous problems. Examples of these problems include absence of a policy to guide IT application, little or no planning for information technology, inadequate awareness for IT, lack of skilled personnel, a culture of corruption that goes down to almost the lowest levels of decision-making, and general resistance to implementation of computer technology.

In this paper, we will focus on information technology and economic development rather than information technology and human development. Even with this narrower focus, it is apparent that implementation of information technology in economically developing countries contributes very little towards economic development. Further, implementation of information technology together with its contribution to economic development is a more

complicated issue than one might initially think. One question that immediately comes to mind is economic development at what level? If one takes this level to be national then the issue becomes how to translate any economic benefit at an organisational or community level, at which most information technologies tend to be implemented, into economic benefits at the national level. The debate that this triggers is beyond the scope of this paper and relates to issues such as national fiscal policies. It is much easier, therefore, to focus on the relationship between implementation of information technology and economic benefits at a lower level, the organisation and the community.

The paper examines some of the important issues and problems in implementation of large IT projects[2] with regard to their contribution towards economic benefits at organisational or community levels. Although it is recognised that issues and problems in the public sector can be quite different from those in the private sector, this paper deals with issues and problems found in both sectors. It also proposes some strategies that can be useful in successful implementation of such projects in these sectors. Successful implementation here implies facilitation of economic benefits at organisational or community levels.

2. Issues and problems

In this section, we will focus on issues and problems relating to failure of information technology project implementation. Failure here implies that implementation of information technology fails to meet the espoused requirements, and, by implication, does not result in economic development. The discussion focuses on three levels of economic development: national, organizational or community, and individual or group levels.

2.1 National level

2.1.1 Lack of national IT policy

A national IT policy would give guidelines on how information technology would contribute to significant aspects of development as this policy relates, directly or indirectly, to the social, economic and political conditions in a country. Some of the main goals of a national IT policy are to:

1 improve the productivity of national development activities;
2 increase the efficiency of national development services;
3 promote the use of IT in development activities;
4 promote and protect indigenous capabilities; and
5 have rules and regulations governing acquisition of IT products and services.

Many developing economy countries lack IT policies. As a result, IT acquisition, implementation and use is left to individual organisations. These fragmented efforts that often work in isolation increase the chances of IT contributing very little to economic development. It is however to be noted that having an IT policy does not necessarily address the issue at hand. It is necessary, for example, to also have the political will and the commitment to implement this policy.

2.1.2 Unsupportive public sector culture

As argued earlier, the biggest challenge in IT contributing to economic development and to human development lies in computerisation of some of the key sectors controlled by the government and the public sector. One of the most critical issues is how to manage the culture that has evolved in the public sector that tends to hamper implementation of IT projects. Ojo (1992) describes some of the elements of culture found in the public sector in Nigeria, which are, among others, little commitment to public services, over-politicised decision-making, secrecy, and bureaucratic complexity. Onto these, the author adds the following elements:

1 Inadequate IT funding. Most IT departments either do not have a budget or they are limited. This is exacerbated by lack of awareness of the potential role of IT among senior managers. This leads to under-

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2. Although we are talking of implementation of IT in this paper, we however acknowledge that the process of implementation of IT cannot be separated from that of planning and development of the same.

investment in information technology and, at times, reliance on external funding for IT. The latter is associated with technological dependency problems[3]. In telecommunications, where the investment in IT is relatively large, there is lack of adequate funding largely due to a perennial shortage of capital and foreign exchange. This has put many IT projects, with high potentials for economic and human development, on hold. In some of the donor-funded IT projects, which tend to be the majority in the public sector, funding has been known to dry up long before project completion.

2 'Big bang' mentality. There is often preference for the "big bang" approach to implementation of IT rather than the more pragmatic approach involving piloting and learning. This is symptomatic of a culture rooted in quantity or bigness.

3 Autocratic structures. Most functions in government are characterised by a high degree of centralisation of power and control and an autocratic approach to decision-making.

This culture frustrates efforts to realise the intended benefits of implementation of IT projects.

2.1.3 Inadequate infrastructure

As organizations in developing economies increasingly integrate computing and communication technologies, availability and/or reliability of infrastructure, especially power supply and telecommunications infrastructure, are a drawback. Bhatnagar (1992), for example, argues that in many less developed countries, the telecommunications infrastructure is outmoded and expensive to use. In some of the countries, the basic power supply and telecommunications infrastructure is available but the level of maintenance support is rather poor. In a university-wide wide area network, which the author is involved in managing, for example, it has been difficult to meet network availability and service objectives. This network relies on dedicated lines belonging to the local public switched telephone network operator which are characterised by poor throughput in terms of data rates and poor state of maintenance. As a result, for instance, response times for remote users of the network are unacceptable.

2.2 Organizational or community level

2.2.1 Lack of planning

At an organisational or community level, the reasons for introducing information technology are many and vary from one context to another. However, there is often no thorough feasibility study done of the need for, and the benefits to be obtained from, IT systems to be acquired. Many organisations at times rely on 'gut feelings' and assurances given by consultants or vendors, who more often than not are incompetent. In other words, the requirements for information technology systems are not determined by, and linked to, an organisation's/community's felt needs before the decision to acquire computing facilities are made. In government departments, for example, IT systems are acquired through aid packages and used largely as administrative tools without serious attention being paid on their possible role in the projects being funded.

Further, in other situations, it is not uncommon to find that computers have been acquired because it is prestigious or an indication of social status to have a PC on a manager's desk, or because one came across the use of computers in one's studies. Finally, in yet other situations, there is often a perceived need to keep up with the technology without serious consideration of whether the technology can meet the intended requirements. This can be due to an inadvertent acceptance of technological determinism, which, exacerbated by rapid technological change, makes fast technological obsolescence. Similarly, in choosing a computing solution, there is a tendency to be guided by purely technical considerations without due cognisance of the importance of other intervening factors, such as a supportive organisational culture and structure.

Lack of planning can therefore lead to acquisition of IT systems that have no economic, technical or organisational justification, and can in turn lead to a wasted investment when those systems are abandoned or do

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3. Technological dependency results in a "vicious cycle that maintains less developed countries in a situation of dependence and frustrates their efforts to develop indigenous technological capacity" (Stover, 1984). It also leads to less IT personnel development.

not meet organisational/community requirements. In other words, if IT systems acquisition does not take into consideration the context within which IT will be implemented and the desired impacts, which in some situations can be likened to a solution looking for a problem, it is unlikely to lead to economic benefits. In Kenya, as indeed in many other less industrialized countries, there are numerous examples of 'white elephants' in the name of computerization projects, particularly in the public sector.

Lack of planning means that long-term benefits, which may be related to economic development, may never be realised in IT implementation. Instead, short-term individual/group self-interests are realised. However, it has to be acknowledged that lack of planning does not necessarily lead to failed IT implementation; it only increases the chances of failure. The converse is also true; that is, planning is not a panacea for a successful IT implementation.

2.2.2 Inability to manage change

Inability to manage change is perhaps one of the major reasons underlying implementation of IT project failure. The need to manage change is occasioned by a number of factors. One factor is that information technology systems will tend to have an impact on most aspects of organisational life, including organisational structure, business operations, management processes, business strategies, products and services, peoples' skills, and power relationships. For example, the effect of information technology on information flows has a direct impact on organisational structure. Similarly, IT systems will affect power relationships in an organization. As an example, an early article by Keen (1981) pointed out the importance of politics of organizational change as related to information systems. A classic case study by Markus (1983) described power and political action over an extended period of several years in the introduction of a financial information system that had significant effects on both divisionalised and centralised accounting functions that led to a major conflict between them.

Further, advances in IT is enabling end-users to acquire technological skills and greatly changing the organisational technical skills base. Lastly, IT innovations have been used by organisations as bases for new products and services. An example is the way integration of computing and telecommunications technologies has provided new customer services in electronic funds transfer at the point of sale (EFTPOS) and home banking in the financial services sector.

A second factor is that organisations/communities will tend to display a form of 'social inertia' with regard to accepting IT systems. Social inertia here has the implication that no matter how hard you try, nothing seems to happen. There are several causes for this. Firstly, organizations/communities can be perceived as complex social systems made up of several interrelated but loosely coupled components (people and their social relations, strategies, technologies, information flows, etc.), see Keen (1981), for example. This argument thus suggests that dramatic changes, such as those that may be brought about by implementation of IT, rarely occur in organisations or communities. This of course is assuming that all other factors are held equal because dramatic changes are possible, especially under circumstances of strong leadership and/or severe crisis. Further, people will make overt and covert moves to maintain the status quo and resist any change. The reasons for this are many and varied and include:

1 perceived erosion of power, authority and autonomy;
2 lack of knowledge of the benefits of IT systems; and
3 lack of involvement in adoption and development of IT systems.

The above argument is not in any way confining management of change to the process of implementing IT. In the process of IT project planning, there is often no evaluation of the ability of the organisation to absorb change, the skills necessary to sustain the systems, the socio-political set-up of the organisation, and organisational culture. That is, part of the problem in managing change is associated with an inability to plan for it right at the outset.

2.2.3. Shortage of skilled personnel

Shortage of skilled IT personnel is one of the most critical issues underlying IT project failure. This is exacerbated by inadequate compensation given to IT staff, and the high turnover of competent IT personnel that characterises the IT industry in many less industrialised countries. Partly due to this problem, many organisations in these countries have tended to employ expatriate staff. These people often lack knowledge about local conditions and culture and, as a consequence, tend to contribute significantly to poor designs and failed implementations. In

addition, most expatriates work on short contracts, thus further making sustainability difficult to achieve.

The shortage is in both technical and managerial personnel. However, the greatest shortage is in people with both technical and managerial skills, particularly in:

1 strategic planning for IT;
2 information analysis;
3 management of IT systems; and
4 management of IT projects.

This inadequacy of skilled IT personnel means that organisations and communities are less likely to realise the benefits, whether economic or otherwise, associated with implementation of IT projects. At the community level, illiteracy is an even bigger problem whose discussion is beyond the scope of this paper.

A further aspect contributing to this problem is the rather narrow perspective on information systems training, largely focused on technology or the technical aspects of IT systems, that has been pursued. For example, most computer science curricula in many economically developing countries are very much oriented towards teaching the technical aspects of IT systems. In other words, they do not cover the socio-political and organisational aspects of IT systems and, therefore, do not adequately prepare graduands to deal with the realities of the complexity of analysis, design and implementation of information technology systems found in organisations.

2.3 Individual or group level

2.3.1 Human malpractices

Human malpractices that affect implementation of IT projects include lack of transparency, corrupt practices and unholy alliances, among others. For example, groups of key actors in IT systems implementation form coalitions, alliances or partnerships of varying strengths across all levels. At the international level, purely economic objectives and incidental dependency dominate the interests of many groups. For instance, the big computer vendors (and their associated manufacturers) want diverse, free, and lucrative markets in which they can generate revenue from their R&D investments. They try to exploit international financing contracts and join with competitors to retain maximum advantages for profits. The purchasers want to master the transferred technology and exploit it to develop their country (Stover, 1984).

This latter rational interest of the developing economy country is often overshadowed by political and economic power interests of individuals and groups (Waema & Walsham, 1990). In the process of IT acquisition, powerful individuals and groups in public organisations may, in pursuit of their self-interests, engage in 'unholy' alliances with providers of IT products and services. In some situations, IT projects are created as a way of siphoning public funds by people who are either politically powerful or are protected by persons with immense political power. As a consequence, awards of IT contracts are based little on competence, merit and so on, but on other considerations that promise benefits to all parties. One of the serious consequences of this has been poor execution of contracts. For example, computer vendors, who have been more of pushers of computer hardware and packaged software, often provide poor training, maintenance and support services. This has been exacerbated by high information technology illiteracy at most top levels of decision making.

The self-interests of individuals or groups cited above will compromise the rational objectives the implementation of IT projects are supposed to achieve.

3. Strategies towards successful implementation of IT projects

If information technology is to contribute towards economic development it is necessary that IT projects are successfully implemented. We argue that the successful implementation of IT projects has higher chances of contributing towards economic development. However successful implementation of an IT project and its contribution towards economic development depends on other factors such as national and sectoral plans, and other activities beyond the focal organisation/community where the IT project is implemented. In other words, other linkages may have to be in place to ensure that a successful implementation translates, directly or indirectly, into economic development at an organisational/community level or higher levels.

In this section, we will outline some of the strategies that can lead to successful implementation of information technology projects. These strategies are discussed under the three levels of economic development:

national, organizational or community, and individual or group levels. However, since IT projects are implemented at organizational or community level, most strategies are discussed at this level.

3.1 National level

3.1.1 Creation of enabling environments by governments

Many developing economy countries have not given IT systems a central role in the management of their economies, just like many organisations in these countries have not placed IT systems at the centre of their businesses, particularly in situations where IT has a strategic business impact. Some countries, however, have recognised the potential role of IT and have evolved IT policies and plans with specific and identifiable objectives linked to economic growth. Others have only given lip service to information technology systems and their role in national socio-economic development.

One way of creating an enabling environment for indigenous IT development is through developing IT policies that are closely allied to the national socio-economic policies. For example, an IT policy can encourage the evolution of a software industry capable of eventually developing software for the local, regional and international markets. In most of our developing economies, IT development takes place without a guiding policy, increasing the chances of IT investments that do not contribute to the country's socio-economic development. The role of governments in IT policy development includes:

1 providing the necessary legislative, institutional, financial and infrastructural mechanisms for formation, implementation and review of policy;
2 establishing a body, or using an existing one, charged with the responsibility for policy development; and
3 developing an IT plan which is included in the national development plan.

Governments can also create enabling environments for IT by liberalising those sectors of the economy that stifle development and implementation of information technology. In the provision of an adequate and reliable telecommunications infrastructure, for example, governments ought to invite competition in areas where the private sector can make a positive impact, for example, in urban areas.

3.1.2 Cultural re-orientation by governments

Governments can also create a context conducive to successful IT implementation by creating a culture of IT use in government and business. In government and the public sector, for example, the desired changes include:

1 Democratic structures. There is a need to shift from autocratic structures to more democratic structures. Closely associated with this it the need to significantly decentralise decision-making, power and control to lower levels.
2 Strategic thinking. There is need to shift from short-term oriented considerations to strategic thinking at organizational, sectoral and national levels, with respect to IT investment. Although many developing economy governments are embracing economic liberalisation, it is important that they do strategic thinking in order to direct the private sector to the special needs of the domestic economy.
3 Less political power dominance. In IT decision-making, as in other decision-making situations in the public sector, there is a tendency for political power to dominate or insubordinate all other forms of power. This is largely due to the politicised decision-making culture referred to earlier. There is need for more rational considerations, such as the priority information requirements and professional IT opinion, to carry the day.

3.2 Organizational or community level

The strategies that are discussed at this level are highly inter-related. It will therefore be uncommon to find one strategy referring to material in another strategy.

3.2.1 Effective project leadership

The concept of leadership has many definitions. Bennis and Nanus (1985) conceptualise leadership as what gives an organization its vision and its ability to translate that vision into reality. A closely related view is that held by Smircich and Morgan (1982). They argue that leadership is perceived as socially constructed and that effective leadership depends on the ability to shape and interpret situations to guide organizational members into a common

interpretation or sense of reality. Bryman (1986) contains other common definitions of leadership.

An effective project leadership[4] is arguably one of the important pre-requisites to successful implementation of IT. This leadership should, for example, diagnose and pick up actual and potential resistance to change and conflicts as valuable signals of the way emerging information technology systems might affect the status quo, bring those into the fore and try to resolve them through discussion and negotiation. Further, the leadership must focus on the change required in implementation of IT projects and provide effective vision for the role of IT systems in the organisation or community. The effectiveness in this will depend upon the ability of the leadership to have a holistic picture of the change process and to guide organisational members into a common sense of reality regarding changes associated with implementation of IT. The sign of success is when all those concerned with the implementation of IT become self-motivated and change is perceived to be based on 'felt need'.

Finally, the project leadership needs to manage the change process, providing the vision of how to manage change. Part of this is to ensure that implementation of IT is in line with the social, organisational and political context in which it is implemented. It cannot afford to be divorced from this context, particularly when this context is critical in carrying out the processes to be automated. For example, if valued social relations are important in the process to be computerised, then implementation of IT that undermines those relations is likely to fail. The person providing IT project leadership must therefore provide a vision of how to relate information technology to this context. This person must lead others (analysts, designers, programmers, etc.) in taking cognisance of the context of implementation, to recognise its importance relative to the success of the project and to implement IT systems that support critical aspects of this context. If this is done, it will lead to a readier acceptance of the system and to IT systems more likely to meet espoused project objectives than when this context is ignored.

Following the above argument, the person providing leadership of the IT project should therefore have:

1 technological confidence, for example to help align IT systems investment to business needs, give direction to IT activities, and work with senior IT staff;

2 business competence - a knowledge and experience base of business and management so that he/she knows what IT is good for business, can construct IT system visions for the business, negotiate with both users and management, etc.; and

3 organisational skills - have organisational and political skills as expected of any senior manager.

One inevitable conclusion from the above discussion is that the person providing project leadership, in a context where IT systems are critical to organisational business, must be a senior manager, must have full authority and resources to negotiate with users and management, and must have multiple skills (technical, business, organisational, and political).

3.2.2. Empowering users

The information systems literature has always talked of the importance of user participation in relation to successful implementation of IT projects (see, for example, Mumford (1984) and Hirschheim (1985)). While user participation can contribute to success in implementation of IT projects, we argue here for a concept that goes beyond user participation. This is the concept of empowering users so that they can have more power to control their activities. It encompasses education and training of systems users so that they can participate in or even carry out planning, development and implementation of IT systems, make the right choices in IT acquisition and use systems more effectively. Education and training is covered separately in the next sub-section. The concept also includes user participation in most stages of IT systems cycle, preferably from the planning stage.

These two methods of empowerment (education and training, and participation) ensure that users get a feel of ownership of the system and are motivated and offer their commitment to implementing and using the systems. In addition, IT systems are more likely to meet the anticipated user requirements and thus lead to few chances of resistance to change. A high degree of user participation is however negated by the autocratic structures found in most developing economy organisations. It is also negated by the elitism of IT systems, particularly when referring

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4. Project leadership is normally provided by one person but it may be provided by a number of persons, e.g. the information systems manager and the project leader.

to technology implementations that touch on rural communities.

In these communities, for example, the daily struggle for basic survival absorbs so much energy that genuine participation is, for all practical purposes, a luxury. This problem is compounded by the high level of illiteracy found in our rural populations. The author acknowledges that IT implementation in the rural context has unique characteristics whose discussion is beyond the scope of this paper. However, whatever the context, whether rural or urban, a case is here made of the importance of de-mystifying computer-based information systems to allow for broad-based participation. Some aspects of this, such as awareness creation, are covered in the next sub-section on education and training.

User participation, however, needs to be balanced with system delivery on time and within budget because excessive involvement can often be time-consuming. As an example, Walsham and Waema (1994) give an interesting case involving different concepts of participation in systems design and development during two periods of different management styles. In particular, the case highlights management concerns regarding excessive user participation using formal systems design and implementation methods. At a more general level, the extent of participation depends on the context of the system under implementation, such as the ability of users to effectively participate in it, the uses of the system and its potential organisational/community impact.

3.2.3. Education and training

Education and training is important in empowering users to participate in and contribute to IT implementation, in managing change associated with IT implementation, and in effectively implementing IT in general.

In order for implementation of IT and management of associated change to be successful, there is need for development of education and training programmes to focus on:

1 raising management awareness and understanding of how important IT systems are for the priority requirements, enabling them make intelligent decisions about IT systems with respect to their possible impacts on the priority goals and objectives;
2 ensuring end-user effectiveness in using IT systems in their specific application areas;
3 building user and senior management awareness of, understanding of, confidence in and commitment to the need to change and the change itself; and
4 acquisition of appropriate technical skills as well as management and business skills for most categories of staff in accordance with priority organisational/community needs. This will help end the elitist culture cited earlier.

On the other hand, in order for these programmes to contribute towards successful implementation of IT projects, they must, among other things:

1 focus on specific training needs of the various target groups;
2 change value systems and reinforce/integrate any important value systems;
3 ensure that introduced IT systems can be used effectively and efficiently vis-a-vis the original objectives; and
4 be frequently updated and modified to ensure relevance.

3.2.4 Experimentation, piloting and learning

IT projects, particularly those that involve rural communities, take a long time to be considered to have been successfully implemented by all significant stakeholders. This is largely because IT systems implementations often involve a change in attitudes, which tends to take a long time. There is need for a careful approach to implementation otherwise one runs the risk of the technology being rejected or resisted. One possible approach, especially for large IT projects, is to experiment with computers until they become accepted as basic productivity tools. This experimentation period will be one of learning on how to use computers, getting rid of any hang-ups about computers and building capacity for more effective use of computer systems. Thereafter, the targeted IT systems can be implemented in several phases learning in earlier phases can be used in later phases. In situations where the IT system is to be implemented in several sites, it is important that there is pilot implementation at one site. The learning at this pilot site would then be used in implementation in other sites, taking due cognisance of the differences in context.

This implies that implementation of large IT projects, particularly those that touch on rural communities, can often take a long implementation time frame. When projects take a long time to implement, we are often quick at condemning them as failures. Nevertheless, it is argued here that if we have the skills to manage this change process and the requisite patience, it is indeed such situations that may have a chance of higher IT implementation sustainability.

3.3 Individual or group level

Some of the issues discussed at the higher levels have an impact at the individual or group level. For example, creation of a supportive public sector culture at the national level is likely to have impacts on individuals and/or groups.

Some strategies that could be useful at this level include:

1 Lobbying - Academics and practitioners, either as groups (e.g. professional associations) or individuals, can lobby to influence the direction of development of the IT sector in a country. At the highest level, for example, these people or groups can lobby, using all manner of public media fora, to influence IT policy and the creation of a culture conducive to successful IT implementation (e.g. adherence to certain acceptable standards).

2 Value systems change - Although it may be argued that changing the value systems that adversely affect IT implementation can be effected from the top, there is however so much that we can do as individuals or groups in changing these value systems. The value systems that we need to change relate to:
- positive attitudes towards work, e.g. more concern for posterity;
- commitment to high quality of products and services;
- more honesty; and
- rejection of nepotism, tribalism, corruption and other human malpractices.

A full discussion on these value systems is beyond the scope of this paper.

4. Conclusions

It has been argued that there is a great potential for information technology to contribute to economic development. However, experience shows that many IT projects implemented have been a failure, contributing very little to economic development. The issues and problems that have led to this sorry state of affairs have been identified and discussed at three levels. These are lack of national IT policies, lack of unsupportive public sector culture, and inadequate infrastructure at the national level; lack of planning, inability to manage change associated with implementation of IT, and shortage of skilled manpower at the organizational or community level; and a myriad of human malpractices at the individual or group level.

In addition, some strategies towards more successful implementation of IT systems have been discussed at the same three levels. These strategies are creation of an enabling environment and cultural re-orientation by governments at the national level; effective leadership, empowering systems users, education and training, and experimentation, piloting and learning at the organizational or community level; and lobbying and value systems changes at the individual or group level. It is argued that the successful implementation of IT has higher chances of contributing towards economic development. It has however been recognised that this may not necessarily be so because other linkages have to be established to ensure that a successful implementation translates, directly or indirectly, into economic development at organisational/community or higher levels.

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Sustainability of governmental use of microcomputer-based information technology in Kenya

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Abstract
This paper explores some critical issues in the sustainability of governmental use of microcomputer technology in Kenya. It is based on a study which was motivated by the rapid expansion in governmental use of microcomputer technology and the continued dependence on external support for its beneficial use. The principal variables studied were: demand for microcomputer technology, its appropriateness and the local technological capacity requirements. The subjects for the study were senior government officers and technical advisors in five ministries which make extensive use of the technology. Questionnaires, interviews, examination of records, and direct observations were used for data collection. The study found that high demand exists for governmental use of microcomputer technology in Kenya; that the technology is appropriate for use in developing country environments; and that the existing local technological capacity is insufficient to sustain beneficial use of the technology without external support. Additionally, a number of issues emerged that have important bearing on sustained governmental use of microcomputer-based information technology (IT). These relate to diverse and incoherent contract and project management practices and to lack of government-wide standards and guidelines for harmonizing and integrating the development of information systems (IS) and IT. The study made a number of recommendations to address these issues.

1. Introduction

Governmental use of computer-based information technology (IT) in Kenya goes back to early 1950s when a tabulating machine was acquired by the Police Department for use in processing crime statistics. In early 1960s, a mainframe computer system was installed in the Treasury for accounting and payroll processing applications. These machines were later replaced with more powerful ones that are still in use. At the same time, Government Computer Services (GCS) was established as a department in the Treasury to provide centralized government-wide computing services. Thus, GCS became the government's computer center providing bureau services on data processing.

The changing economic misfortunes experienced in 1970s and early 1980s compelled the government to take a number of policy measures, the implementation of which required accurate and timely information for rapid management decisions and actions. GCS, being essentially a data processing center providing bureau services was therefore unable to provide the information required for these type of applications. Microcomputer technology was thus introduced in response to this need.

The Ministry of Agriculture (MOA) and Livestock Development pioneered governmental use of microcomputer technology in 1981. Then, the Ministry's budgeting and expenditure monitoring and control was said to be weak and the Treasury demanded improvements (Pinckney, et al., 1982). This effort resulted in significant improvements in the performance of the Ministry in these areas. The successful application of the technology in MOA led to the introduction of the technology in the Ministry of Planning (MOP) in 1983. The need here was the processing of district development plans that were needed to implement a new policy initiative which placed the district at the center of rural development planning and management activities (Republic of Kenya, 1983). Again, as was the case with MOA, significant successes were achieved.

The successful experiences in MOA and MOP lead to the introduction of the technology in the Ministry of Finance for use in the processing of the national budget, where serious problems were being experienced. This was an ambitious project as it was the first time that microcomputers were ever used for processing a national

budget anywhere in the world (Wescott, 1985; Peterson, 1989). The successful application of the technology in budgeting led to the development of related financial ISs such accounting, pensions, bank reconciliation, and appropriation systems.

Today, governmental use of microcomputer technology is widespread and is rapidly expanding in almost all ministries and departments. Computerization efforts were initially supported through donor funded projects. The same projects also provided technical assistance personnel required to install the technology and develop the required application systems. This apparent dependence on donor funding and technical assistance brings out the issue of technological sustainability. This paper examines the critical issues and considerations in the sustainability of governmental use of microcomputer based information technology in Kenya. It is based on a study conducted by the author in 1991 and recently updated for the purposes of this paper (Oyomno, 1991).

1.1 The problem

Governmental use of microcomputer technology in Kenya, and indeed in many developing countries, was motivated by the practical need to strengthen management in public organizations by providing accurate and timely information upon which to base management decisions and actions. The technology was introduced in those areas considered to be critical to the performance of these organizations. Significant improvements in the quality of management decisions and consequently the overall performance of these organizations were reported (Pinckney, et al., 1982; Wescott, 1985). This raised the demand for the technology in these organizations.

The introduction and continued use of the technology was supported with funds and technical assistance from donor agencies. These have ordinarily been packaged into projects contracted to implementing agencies, usually consulting firms. These projects have primarily focused their activities on the development and delivery of specific outputs in terms of IS and technology within specified limited time frames. Little or no provisions have been made for building the technological capacity of recipient organizations to sustain beneficial use of the technology beyond the lives of the projects. Consequently, continuity has been provided through project renewals or extensions. However, repeated project renewals suggest lack of institutional capacity to sustain the use of the new technology on internal organizational resources. It also perpetuates dependency by these organizations on external resources over which they have no control, and on a technology they cannot support on their internal resources. The problem arising from this, which was the subject for the study, was to establish whether governmental use of microcomputer based IT in developing countries is sustainable. In other words, can continued beneficial use of the technology in these countries be sustained on internal governmental resources beyond the lives of these projects without dependence on external financial and technical assistance? What critical issues must be addressed to ensure that governmental use of microcomputer-based IT is sustainable?

1.2 Objectives and motivation

This paper addresses the sustainability of governmental use of microcomputer-based information technology in Kenya. The question here is whether or not sustainable use of the technology can be attained without dependence on external assistance. A number of considerations motivated this examination. First, there is the question of management strengthening in the public organizations of developing countries. It is argued here that sustainable development requires strong and sustainable institutions and organizations, which is turn require strong and sustainable management practices. Strong management practices are not only essential in developing country environments where scarcity of essential resources is the order of the day but are also critically dependent upon the quality of information on which management decisions and actions are based. This is where information systems and technology come in. It is therefore hypothesized that building an effective and sustainable information systems and technology in public institutions will considerably strengthen their management capacities and thereby provide a rational basis for the attainment of sustainable development.

The second motivation relates to the growing realization of the important role of information as an organizational resource, just like land, capital or labour. This is particularly so in the light of accelerated changes being experienced globally in terms of patterns of world economic interdependence, explosive growth in social demands, especially in the developing world, and increasingly complex technological changes (Sagasti, 1991). Under such circumstances, management efficiency and effectiveness are critically dependent on the availability of accurate and timely information. This is especially so in developing countries where essential resources are scarce. In this

light, the need for sustainable technology to provide the required information is critical.

Third, a culture of perpetual dependence on external assistance is assuming unacceptable proportions in Kenya as well as in most developing countries. Although microcomputer technology has been used by the government for over a decade, the technology is highly dependent on external technical and financial assistance. This situation raises critical concerns in terms of organizational vulnerability, given that the technology is used in areas that are critical to the performance of these organizations. Furthermore, given the increasingly fragile conditions under which donor support to developing countries is being given, the ability of these countries to sustain beneficial use of the technology without dependence on external assistance is extremely important.

2. Conceptual framework

The study was conceptually founded on three key terms: development, technology and sustainability. The operational definitions of these terms together with their interrelationships are discussed below.

2.1 Development and technology

Development is broadly perceived here as a directed change process that seeks to improve the quality of life. This statements brings out two important factors. First, it brings out the central role of people in any developmental effort. The value of such efforts would be measured in terms of the extent to which they address the true needs of the intended recipients. However, the multidimensional nature of human needs and wants makes developmental efforts fairly complex. Second, the purpose of any developmental effort is to improve the quality of life of its recipients. The success of such efforts must therefore depends on the extent to which they address the wishes and needs of the recipients. They must also underscore the important role of the people in the realization of these needs and wishes. It is under these considerations that Ndegwa, et al. (1987) asserted that "*development is about people*".

Technology is needed in a developmental effort to increase man's capacity to accomplish more. Schon (1973) defines technology as a set of "*tools and techniques which extend the human capacity*", while Schumacher (1977) contends that it "*lightens the burden of work man has to carry out in order to stay alive and develop his potentials*". In both cases, technology is human-enabling in terms of accomplishing tasks essential for continued existence and prosperity. It can be concluded form the above considerations that technology accelerates the pace of development. This statement provides a basic relationship between technology and development. Kiggundu (1989) succinctly established this when he asserted that "*the ultimate purpose of technology is to bring about development by solving predetermined socially important problems*".

The foregoing discussion establishes a functional dependence of development of technology. It should however be noted that this is not a one-to-one relationship. Development is a multivariate function. Additional independent variables include: input resources (such as raw materials, labour), institutional and organizational set-up, and management.

2.2 Sustainability

Sustainability comes in to ensure that the improvements in the quality of life that are achieved as a result of developmental efforts are continuously enjoyed over a long period of time and that further improvements are attainable as the environments change. The futuristic nature of the term is reflected in the broad definition of sustainable development provided by Brundtland (1987): "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*". Following from the dependence of development on technology that has been established above, it can be said that sustainable development is also dependent upon sustainable technology, other factors being equal.

2.3 Information and information technology

In the context of development and the developing world, poverty has for a long time been conceived as being purely an economic phenomenon. This conception explains the unnecessary emphasis that has been placed on economic development as being the solution to poverty-related problems experienced in developing countries. However, lack of progress in the attainment of meaningful development despite massive transfer of capital and economic resources to these countries is clearly bringing out the inadequacy of this conception. It is increasingly becoming acceptable that poverty is a complex and multidimensional concept. Some of these dimensions are: economic, social, political,

institutional, organizational, technological, and informational. For this reason, appropriate approaches and strategies to development are needed that seek to first break down the complexity to manageable levels and then focuses on each taking into consideration all interdependencies. It is argued here that the informational dimension of poverty is critical to the attainment of meaningful and sustainable development. Information provides a basis for directed action. It enhances managerial effectiveness, leading to more efficient utilization of scarce resources and to the attainment of higher levels of development.

Having established the important role of information in the attainment of meaningful and sustainable development, it follows that the technology used to process, preserve and disseminate information is equally important and critical. This view has been amplified by Elmandjra (1985) in his assertion that: "*no development of any kind can take place without a heavy reliance on information and communications technologies*"

2.4 Technology sustainability

The functional dependence of development of technology has been discussed above, and so has that of sustainable development on sustainable technology. Considering the role of technology in a developmental effort, its sustainability can be said to be functionally dependent upon three main variables, namely:

1 the level of demand for the technology;
2 the appropriateness of the technology to the application environment; and
3 the availability of local technological capacity to sustain its beneficial use.

2.4.1 Demand for technology

Demand is a measure of the extent to which the use of a technology is required. The installation and subsequent adoption of a new technology in an organization is driven by the existing level of demand for its use. The higher the demand for a technology the more likely it is to be sustained. Conversely, a technology that is in less demand is less likely to be sustained.

Technology demand was further defined to be functionally dependent upon three variables, namely, the extent to which the applications to which the technology is put are critical to the proper functioning of the organization, the expected productivity that accrued to the organization as a result of using the technology, and the value of the outputs from the technology to the organization.

2.4.2 Technology appropriateness

The appropriateness of technology determines its acceptability and subsequent adoption and institutionalization in a new organizational setting. A technology may be useful and in high demand and yet inappropriate for sustained use (Pinckney, et al., 1982; Brodman, 1986; Kiggundu, 1989). It may be too expensive and/or sophisticated to be supported and maintained on local organizational resources; the financial and human resource requirements for the technology may exceed the organization's endowment, or the adaptive organizational changes required to accommodate it may be too large and drastic to be acceptable.

Technology appropriateness was refined further into three variables: cost-effectiveness, affordability, and suitability. Cost-effectiveness, in turn, was defined in terms of quality of information obtained and the extent to which using technology enriches the jobs of individual members of the organization. Affordability was studied in terms of financial and human resource requirements of the technology, and in terms of the adaptive changes required to fit technology into governmental organizations. Technology suitability was studied in terms of its operational simplicity, flexibility, maintainability and robustness.

2.4.3 Local technological capacity build-up

Kiggundu (1989) defines local technological capacity (LTC) as the:

> *entrepreneurial, technical, managerial, intellectual, institutional, sociopolitical, cultural, and physical resources and infrastructure that exist in an organization (sector or country) and its immediate environment. It is related to the extent to which an organization or a group of organizations is able to utilize effectively its new and existing technology.*

To this extent, it can be said that the creation of an organizational resource infrastructure is essential for continued beneficial use of a new technology. New technologies are generally introduced into developing country organizations

through technical assistance to facilitate their rapid installation and utilization. However, persistent use of technical assistance, even years after the acquisition and installation of the technology, is a strong indication of lack of adequate LTC build-up for the technology in these organizations.

3. Methodology

The study focused on five government ministries, namely, Finance, Planning, Health, Agriculture, and Livestock Development. These ministries were selected because they were among the heaviest users of microcomputer technology, accounting for over 70 percent of governmental use of the technology in Kenya.

Data was collected using four main instruments: observations, examination of official documents, questionnaires and interviews. The data collection instruments were build around the three main independent variables. Each of these variables was further operationalized to measurable entities upon which data was collected. The questionnaire used appear in the appendix.

Of the 250 questionnaires distributed, 159 responses were received, giving a response rate of 63.6 per cent. However, 36 (or 14.4 per cent) of these questionnaires were not fully completed by the respondents and were therefore considered unusable. The results reported here are therefore based on the remaining 123 (or 49.2 per cent) questionnaires.

Interviews were also held with twelve respondents, including ten senior government officers and two technical assistance advisors working in the area of management information systems. Further data were collected through examination of a number of official records, and through direct observations, where such instruments were found to be appropriate. Numeric data were collected using a five-point Likert scale.

Data processing and analysis were accomplished using qualitative and quantitative statistical tools. The qualitative tools used included classification and categorization, while quantitative tools included computations of distribution (frequency and percentage) and means (simple and weighted).

4. The results

The findings of the study confirmed the existence of high demand for governmental use of microcomputer-based IT in Kenya, and the appropriateness of the technology for use in such environments. On the question of LTC, however, little supporting evidence was found.

4.1 Demand

The results obtained indicate that:

1 governmental use of microcomputer technology in the respective organizations studied has focused primarily on those applications that are critical to their effective functioning and operations;
2 increased organizational productivity has resulted in these areas of applications, and
3 the outputs from the technology are highly valued.

These results support the hypothesis that high demand for governmental use of microcomputer technology exists in Kenya.

These findings are further supported by the on-going rapid expansion in the adoption of microcomputer technology for governmental use in Kenya and the increasing extent to which this expansion is funded from local sources. In 1980, there was hardly a microcomputer in use in any government office in Kenya. Today, there are over 3,000 and the number is increasing exponentially. While a substantial number of these computers were obtained through donor-funding, this trend is changing. A fairly large number of computers have been procured through government funding. In the last year, for example, over 500 PCs were procured by the government for use in various ministries. Furthermore, numerous computerization projects have been either initiated or continued on government funding.

4.2 Appropriateness

The results obtained indicate that the use of microcomputer technology is cost-effective, affordable and suitable. The cost-effectiveness of the technology was supported by the findings that the use of the technology increased the quality of information resulting in more timely and effective management decisions and action, and enriched the jobs of government officers involved resulting in higher staff productivity, motivation and morale. Affordability wa

supported by the findings that the financial and human resources and adaptive organizational changes required to develop, install and make effective use of microcomputer technology was minimal and therefore affordable. The findings that microcomputer technology is operationally simple and easy to use, flexible, maintainable and robust supported the hypothesis of its suitability.

All in all, these findings support the appropriateness of microcomputer technology for governmental use. They also explain the rapid expansion in the acquisition and adoption of the technology by different ministries and departments of the government, as has been highlighted above.

4.3 Local technological capacity

The results of the study suggest that more emphasis was placed on the development of specific application systems, and procurement of computing equipment required to implement these applications, than on the creation of the organizational processes required to sustain their beneficial use. Similarly, the provision of both user and professional training was found to be considerably inadequate to meet the high demand that existed in the organizations studied. It was further established that the demand for user training was higher at the higher levels of the organizational hierarchy than at the lower levels. Very little, if any, training was found to have been conducted for these officers. Although computer appreciation and awareness seminars were found to have been conducted for senior officers in the organizations studied, these were largely non skill-based and therefore had little impact on ability of these officers to make effective use of the technology.

These results suggest that the existing LTC was insufficient to provide sustained beneficial use of the technology without dependence on external technical assistance. For one thing, the approaches used in the procurement and development of information systems and technology did not promote the active participation of government officers to facilitate transfer of appropriate skills and expertise. For another, the training provided through contractual arrangements was found to be insufficient to meet the rather high demand found to exist in the organizations studied.

5. Critical issues and recommendations

This study has established the existence of high demand for governmental use of microcomputer-based information technology and that the technology is appropriate for beneficial use in these environments. It has also established that the existing LTC is insufficient to sustain beneficial use of the technology without external technical assistance. Furthermore, additional issues have emerged which pose impediments to the sustainability of the technology in government. These include:

1 Integration of information systems;
2 Coordination of development of information technology;
3 Computerization standards and guidelines;
4 Human resource considerations;
5 Information confidentiality, integrity and security; and
6 Contract and project management.

5.1 Integration of information systems

The computerization practices observed in the ministries studied do not promote the government-wide integration of information systems. The applications developed were tailored to meet the information requirements of the respective ministries and departments. No evidence was found to suggest that provisions were made in their design for inter-organizational information sharing. The dangers posed by this approach are many, including redundancy, duplication of efforts, and incompatibility. All these lead to higher operating costs and inefficient use of scarce resources on a government-wide basis.

Computerization in multi-organizational environments, such as the government, has local as well as global issues to consider. Local issues entail meeting the information requirements of the host organization, while globally consideration is given to maximization of inter-organizational information sharing and minimization of redundancy and duplication of efforts. Addressing global issues require critical examination of the channels of communications and information flows that exist between organizations.

To maintain double foci, integrative strategies, processes and mechanisms for addressing both local and

global issues must be established. The critical information requirements of the host organization must be met, while giving particular attention to inter-organizational information inflows and outflows.

Recommendation 1:

Adopt integrative approaches and strategies for the development of governmental information systems and technology to ensure that the resulting systems are compatible and inter-operable.

5.2 Coordination of IT development

The study found no framework for coordinating the high rate of computerization taking place in the government. This practice promotes the development of organization-specific application systems that cannot permit inter-organizational information sharing where this is desired. It also promotes a proliferation of incompatible IT tools and platforms which cannot support systems inter-operability. Furthermore, it makes the operating costs of these systems rather expensive given the high rates of obsolescence of IT equipment currently experienced.

Considering that computerization involves a substantial amount of investment from the government, it is imperative that organizational processes and procedures are put in place for coordinating their successful implementation and sustainable use. It is in this light that a framework for coordinating computerization efforts be established on a government-wide basis.

Recommendation 2:

Develop a framework for formulation, coordination and implementation IT projects in the Government.

5.3 Computerization standards

Computerization standards are essential in a multi-organizational environment. They provide a basis for coordinating and guiding the development and use of IT in such complex environments. They also provide a framework for quality assurance to ensure that the resulting products meet the minimum requirements specified.

The study established the existence of a large number of incompatible computing facilities in the government. Some of these are not maintainable while others became obsolete even before they arrived and thus have never been used. This clear wastage of valuable and scarce resources is unnecessary and can and should be avoided.

The specific areas in which standards and guidelines are required include: hardware/software specifications, software development, and data naming. Hardware and software specification standards would serve the useful purpose of defining the minimum acceptable technical characteristics for all computing hardware and software. Enforcement of such standards would promote equipment compatibility and permit inter-organizational information sharing. They would also discourage dumping of obsolete technology on the government by ill-intentioned contractors. Software development standards would promote the development of applications which are easy to maintain and enhance and have the potential of cross-organizational use. Data naming standards would ensure systems inter-operability which is essential for information sharing.

Recommendation 3:

Develop standards and guidelines to govern and regulate the development and effective use of information technology by the government.

5.4 Human resource issues

Issues which arose in relation to IT personnel in government service included: lack of local IT professionals, use of technical assistance, and budgetary allocations for training and capacity building.

5.4.1 Local IT professionals

The inadequate number of IT professionals in government service was found to be a critical issue that forces government organizations to depend on technical assistance personnel for their computerization. All the organizations studied confirmed that lack of local professionals was a threat to sustained governmental use of IT. The deployment and motivation of existing IT professionals was found to be a contentious issue. These officers were found to be underutilized, underqualified, and underpaid. Most of the work was undertaken by technical assistance personnel who showed no genuine interest in transferring skills and expertise to local personnel.

A scheme of service for IT professionals in public sector was found to be another problem. Although non-existent at the time of the study, the scheme which has since been implemented is not competitive enough to attract or retain qualified staff in government service. Consequently, the high attrition of qualified staff has not been checked.

Recommendation 4:

Review the existing scheme of service with a view to making it attractive enough to attract and retain qualified IT professionals in public service.

5.4.2 Technical assistance personnel

Further problems were found in the use of technical assistance, especially those hired under personal service contracts (PSC). These assistants performed in positions requiring government officers. Since institutional capacity building is not clearly stated in their contractual terms of reference, they have no obligation to transfer skills and expertise to the local staff. In fact, they created a situation of total dependence on them by senior government officers. In this way, they assured themselves of 'perpetually' contract renewals. These practices considerably stifled institutional capacity building which is essential for sustained use of the technology by the government.

Recommendation 5:

Expand the scope of work of technical assistance personnel to include capacity building so that the skills and expertise they bring are transferred to local personnel over a period of time.

5.4.3 Budgetary allocation for training and staff development

The study further established a disproportionate allocation of project resources to systems development and procurement of computing machinery at the expense of creating an organizational capacity necessary for their sustained use. There is need to establish a proper balance between delivering the required information systems (product orientation) and ensuring a progressive LTC build-up within the organization (process orientation). Deliberate efforts must be made to progressively transfer knowledge, skills and expertise from technical assistance personnel to government officers. Several suggestions were made for the accomplishment of this. First, the specification of computerization projects should ensure a proper mix of product and process orientations. Second, government officers should be actively involved in all computerization activities and projects. This provides an effective on-the-job training.

Recommendation 6:

Increase the proportion of budgetary allocation for training and capacity building in computerization projects.

5.5 Confidentiality, integrity and security

Data integrity and security is yet another area where contentious issues were raised. Information confidentiality is essential at all levels, be it individual, organizational, governmental, or national. It is known that the use of computers, without proper measures to ensure data security and integrity, can lead to unauthorized persons having access to information that could be damaging to an individual, organization or government. Another problem relates to computer fraud, a familiar phenomenon in banks world-wide. Standards and guidelines in these areas would greatly enhance governmental use of IT while protecting and maintaining information confidentiality in areas where it is essential.

Currently, Kenya has no laws relating to the access and use of computer information. In fact, such information cannot be produced as evidence in a court of law. This situation can stifle the development and use of information technology especially in areas where legal matters are concerned. Yet, computer use is increasingly becoming indispensable in a number of areas. In banks, for example, it is inconceivable that they can operate at all, let alone effectively, without the use of information and communications technology. Even within the government itself, it is inconceivable that the Ministry of Finance would operate effectively without the use of computers, considering the introduction of microcomputer technology was motivated by the collapse of the manual systems in mid 1980s.

Granting that IT has become an indispensable part of organizational life world-wide and that its use holds the promise for attaining meaningful development in developing countries, it is imperative that necessary measures

be taken to ensure that adequate protection is provided for computer maintained data. This would ensure that their confidentiality, integrity and security is maintained within the legal framework so that the right of individuals and institutions are protected and preserved.

Recommendation 7:

Enact laws and regulations for governing and regulating the right to access and use of information maintained in magnetic and electronic media.

5.6 Project and contact management practices

Contract management was found to be an area of serious concern with respect to sustained governmental use of IT. A number of issues arose. First, the procurement process was raised as a critical issue. The requirements specifications given in the request for bid documents were found to be unclear and confusing. They thus failed to provide a reasonable yardstick for comparing different bid proposals. Second, the evaluation of such bid proposals were essentially based on considering the financial proposals, disregarding the technical proposal. In engineering procurement, it is possible to base selection decisions solely on financial proposal since the technical requirements are well-defined and specified. The same level of technical specificity cannot be achieved in computerization procurement, especially in the areas of software development. For this reason, the technical proposals are extremely important in establishing the ability of the bidder to deliver the required products and services.

The third problem relates to the extent to which hardware considerations are emphasized in the procurement of IT. Computerization entails a lot more than just hardware procurement. Meaningful and effective computerization must place at the focal point the application to which the technology would be put, namely, management of information as a critical organizational resource. It is in this light of contention that effective computerization begins with, and is driven by, factors relating to the nature and amount of information to be processed, stored, published and the use made of it thereof. Thus, information is a central consideration in the development of an effective computer system. To this end, it can be asserted that computerization is first and foremost a management matter and not a technical one.

Fourth, the overdependence of hardware vendors for advisory matters pertaining to computerization was found to be an issue. Seeking advise from a vendor of a particular brand of computer hardware is like consulting a car dealer on which make or model of car one should purchase. In such cases, the results of such consultation should be obvious even before they are made. The need to divorce computerization issues from being seen as comprising of only hardware considerations is crucial to the development and effective use of computer technology. Effective computerization should seek to establish a triple balance among hardware, software and 'orgware' considerations so that a best fit is found for the technology. The bottom line in these considerations is availing the right information to the right people at the right time and in the right manner and quantity.

These problems and issues point to weaknesses in the manner in which computerization contracts and projects are managed, and calls for an institutional framework for managing them.

Recommendation 8:

Set up a government-wide institutional framework for developing and managing computerization contracts and projects to ensure that the information requirements of the organizations are emphasized.

6. Conclusions

This study has established the existence of high demand for governmental use of microcomputer based information technology in Kenya, and that the technology is appropriate for use in developing country environments. On LTC, however, it has been established that insufficient efforts have been made to facilitate effective transfer of relevant technical and user skills, expertise and experience.

On the basis of these results, therefore, the research question, posed above, can be answered as YES, BUT ... YES because there is high demand for the governmental use of microcomputer based information technology in Kenya and the technology is appropriate for sustained beneficial use in developing country environments. BUT the existing LTC for microcomputer technology is insufficient for sustained beneficial use of the technology without external assistance.

These findings support the conclusion that governmental use of microcomputer based information technology in Kenya has the potential for sustainability. However, it has not as yet attained a level of sustainability

due to lack of LTC for the technology. Furthermore, the study uncovered a number of institutional and organizational considerations which impose additional constraints to sustained governmental use of microcomputer technology in Kenya.

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Appendix

Research Questionnaire

Instructions

The questions presented here are either multiple choice or single-answer fill-in type. Each multiple-choice question has five options, ***A*** *to* ***E****. Select the options that best answers the question, and then* ***PLACE MARK (A TICK OR AN X) IN THE BOX*** *corresponding to this choice on the grid. Each grid has a key above it explaining what each letter heading in each column represents. Where your response differs from all the options provided, please specify your response separately on the paper or in the space provided.*

1. In the space below, state one of the major tasks, functions or applications that microcomputers are used for in your ministry

2. Before this task/function/application was computerized, what method was used to accomplish it?

METHOD USED	RESPONSE
Manual methods	
Mainframe computer	
Minicomputer	
Combination of manual and mainframe	
Combination of manual and minicomputer	
Combination of manual, mainframe and minicomputers	

3. ***How does using microcomputers compare with the old methods of accomplishing this function in terms of the following:***

KEY: A - Much lower B - Lower
C - Same D - Higher
E - Much higher

	A	B	C	D	E
Effort required to produce the information					
Time required to produce the information					
Quality of information obtained					
Frequency of production and use of information					

4. ***How has the introduction and use of microcomputer technology affected the standards of performance maintained in your ministry in this area?***

OPTIONS/CHOICES	RESPONSE
They have been considerably increased	
They have increased	
They have remained the same	
They have decreased	
They have considerably decreased	

5. ***What is the position of the most senior officer in your ministry that uses the information processed using microcomputer technology?***

OPTIONS/CHOICES	RESPONSE
Minister	
Permanent Secretary	
Head of department	
Deputy Head of Department	
Others (please specify here)	

6. ***With what level of confidentiality is the information obtained from this application treated?***

OPTIONS/CHOICES	RESPONSE
Much higher level of confidentiality	
Higher level of confidentiality	
The same level of confidentiality	
Lower level of confidentiality	
Much lower level of confidentiality	

7. ***How does the quality of information obtained using microcomputers compare with that obtained by the old methods:***

KEY: A - Much higher B - Higher
C - Same as before D - Lower
E - Much lower

	A	B	C	D	E
Accuracy					
Timeliness					
Relevance					
Adequacy					
Availability					
Accessibility					

8. ***Given your experience with microcomputers, what would you say about the technology in respect of the following:***

KEY: A - Very easy B - easy
C - Fair D - Difficult
E - Very difficult

	A	B	C	D	E
Learning to use a microcomputer					
Setting up a microcomputer for use					
Using a microcomputer to solve a problem					

9. ***What is your assessment of the level of effort required to accomplish the following tasks using microcomputer technology?***

KEY: A - Very Easy B - Easy
C - Fair D - Difficult
E - Very Difficult

	A	B	C	D	E
Systems modification to meet changing needs					
Systems expansion to meet increasing demands					
Systems adaptation to new requirements					

10. ***To what extent has the adoption of microcomputer technology in your organization affected your position in the organization in the following respects:***

KEY: A - Considerably increased B - Increased
C - No change D - Decreased
E - Considerably decreased

	A	B	C	D	E
Prestige					
Responsibilities					
Accountability					
Job performance/productivity					
Level of motivation					
Job satisfaction					

11. ***What is your assessment of the Government's ability to meet the following costs relating to the use of microcomputers on a long term basis without dependence on external assistance?***

KEY: A - Very able B - Able
C - Doubtful D - Unable
E - Very unable

	A	B	C	D	E
Operating costs					
Equipment maintenance costs					
Equipment replacement costs					
Personnel costs (personal emoluments)					
Training costs					

12. ***What is the existing supply of the following computer professional in your organization?***

KEY: A - Very adequate
B - adequate
C - fair
D - Inadequate
E - Very inadequate

	A	B	C	D	E
Information systems managers					
Information systems analysts					
Computer programmer					
Computer technicians					

13. What is the existing level of demand for the following computer professional in your Ministry?

KEY: A - Very high B - high
C - fair D - Low
E - Very low

	A	B	C	D	E
Information systems managers					
Information systems analysts					
Computer programmer					
Computer technicians					

14. How does the level of involvement of government officers compare with that of technical advisors in the following activities in the computerization of your Ministry:

KEY: A - Much higher
B - Higher C - The same
D - Lower E - Much lower

	A	B	C	D	E
Assessment of information needs					
Specification of information systems					
Selection of computer equipment					
Installation of microcomputers					
Development of application systems					
Production of required information					
Management of systems development efforts					
Management of information systems					
Advice to senior officers on information technology					

15. To what extent have the following officers been trained in the use and management of microcomputer systems in your organization?

KEY: A - Very adequate
B - Fairly adequate
C - Adequate
D - Less adequate
E - Very inadequate

	A	B	C	D	E
Clerical and secretarial staff					
Supervisory staff					
Middle management					
Top management					

16. To what extent is training necessary for the following categories of microcomputer users in your organization?

KEY: A - Very necessary B - Necessary
C - Either way D - Unnecessary
E - Completely unnecessary

	A	B	C	D	E
Clerical and secretarial staff					
Supervisory staff					
Middle management					
Top management					

Good use and misuse of analysis applications for decision support in enterprises

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Abstract
In most enterprises in developing countries computers are used for relatively simple applications such as basic accounting and invoicing. This means that the potential benefits of computers as instruments for analysis are very often unexploited. An explanation may be managers' lack of experience and habits in using information as a resource in business decisions and operations. But it can also be ascribed to the fact that many analysis applications are less appropriate in developing contexts. This is the case when analysis is based on predefined models of Western origin, developed for one type of settings only and not transferable between different cultural and socio-economic contexts. It is therefore important to distinguish between the two types of analysis applications which are predominant in information technology use: the simple application which does not require that causes and effects are explicitly articulated in a model and the more advanced application requiring strong correspondence between the computer model and its application. Managers' resistance to using computers for analysis is probably explained by lack of understanding of the nature and benefits of simple analysis. The paper draws on findings from earlier research in Egypt and compares it with more recent interviews with managers in African enterprises.

1. Introduction

Ten years ago I initiated a joint project between the Cairo University and the Royal Institute of Technology in Stockholm. The project focus was on computers in industry, and it analyzed the usability and applicability of computerized production control systems in three Egyptian enterprises[1]. The theoretical framework for the analysis was based on an approach where the enterprises were regarded as open systems, operating in an environment characterized by constraints and contingencies.

The detailed findings from the project, which lasted for four years, will not be repeated here. Interested readers will find details in Lind (1988). For more general discussion about the applicability of models in a wider development perspective see Lind (1991).

A general observation from the study was that the more normative the computer application, the more its usefulness depends on how the cause-effect relations have been defined. Cause-effect relations explicitly built into the computer model (predefined relations) become less useful in enterprises exposed to genuine uncertainty and contingency. One reason for this is the inability of formal systems to cope with unpredictability.

The Egyptian study thus showed that production planning models require that lead-times can be explicitly determined, at least with statistical significance. In an environment, however, which is characterized by contingencies that make predictions hazardous, the cause-effect pattern becomes too complex to fit into a computer model. The usefulness of the analysis applications was therefore very limited as the production models were based on assumptions which could not be taken for granted in Egypt.

When modelling of reality is not a pre-requisite for the analysis application, then the system can be more easily adapted to various environment conditions. For example in inventory analysis, it is not necessary to know the underlying cause-affect relations of the flow of goods as long as the analysis is restricted to number and value of used material. Quite often, considerable benefits can be achieved with very simple analysis models!

However, managers in developing countries are in general poor users of even simple business and operation analysis. As new trends in business management identify information technology as a means to improve

[1]The three enterprises were NASCO (vehicles), Helwan Iron and Steel and El Mehalla and Cobra (textile).

competitiveness and business performance, it is necessary for managers to become familiar with and learn to use the new tools. Removing obstacles and factors which may hamper analysis applications is therefore of vital importance.

2. Preconditions for analysis in developing countries

The following distinction is used here between processing and analysis applications: By processing we understand a type of application that improves the throughput of transactions, for example, invoicing and payroll. Processing applications often use standard packages. Analysis applications can be of two kinds, simple and advanced: by simple analysis we understand applications where transaction data, collected for processing is further elaborated and recombined according to simple rules. By advanced analysis we understand applications where dedicated data is elaborated and recombined according to complex, pre-developed models.

It has been argued (e.g. Zubhoff, 1988) that a company does not benefit fully from computer usage until it is also applied to analysis applications. In the very recent concepts for improved competitiveness among small and medium enterprises, information technology has thus been highlighted as a vital tool to assist managers in analyzing business opportunities[2].

Although new business concepts, focusing on quality and responsiveness to customer requirements have been accepted also by most managers in developing countries, simple analysis is still very rare. This may have different explanations. Peterson (1991) identified, within Kenyan bureaucracy, a number of constraints to using IT for analysis. The constraints have been examined in terms of demand for analysis and supply of relevant data/information as illustrated in the following figure (figure 1).

	Individual	**Institutional**
Demand	*** Limited use of information in decision making** Unwillingness of managers to delegate access to information.	Authority threatened by widening access to information.
Supply	*** Weak analytic skills** Lack of typing skills. Stifled initiative. High risk of asserting judgement.	Poor staff development. Lack of incentives. *** Weak computer support.** *** Limited counterparting by technical advisors.**

Figure 1: Constraints to using microcomputers for analysis in Kenyan bureaucracy (Peterson, 1991)

Studies of management behaviour in African private sector enterprises reveal similar patterns[3], in particular in the highlighted areas of figure 1 above. Even if managers in these enterprises show less reluctance to analysis applications in general, there is a certain resistance to depending on information in decision making. Instead, decisions are often made incrementaly from previous commitments with little resort to analysis.

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[2]Such a concept is for example World Class Manufacturing (Maskel, 1991).

[3]Around 70 small and medium enterprises managers were interviewed as to the usage of analysis applications for decision support. The enterprises were in Kenya, Malawi, Zambia, Congo, Cameroon, Ghana and Senegal.

Limited use of information in decision making can also be ascribed to a general lack of awareness and understanding among managers regarding driving forces for productivity and performance. Without such awareness, an important incentive is missing to learn and adopt business analysis methods for the assessment of product profitability, cost/benefit evaluation, performance and productivity.

Such analysis is particularly suitable for modern PC systems. But managers need to improve their analytic skills in order to successfully work with analytic instruments. This implies, for example, to correctly interpret average values and percentages as well as indexes and time series. These type of skills are more or less taken for granted in management literature and training courses. In training and in the design of analysis tools for managers in developing countries, however, these difficulties must not be underestimated.

At the same time as it is accepted that managers need to become aware of the importance of information as a vital business operations tool, there is also a need to realize that constraints to using IT for analysis do not only come from lack of individual and institutional demand and supply. Lack of correspondence between reality and model hampers the use of IT for certain types of analysis. When managers in developing enterprises are encouraged to adopt analysis applications and to become more involved in these kind of business practises, it is necessary not to overemphasize the use of advanced analysis applications.

3. The Computer as a management tool

The computer as a management tool means that information is provided from raw data to support analysis and decisions. The diagram below (figure 2) is used to illustrate such an information flow.

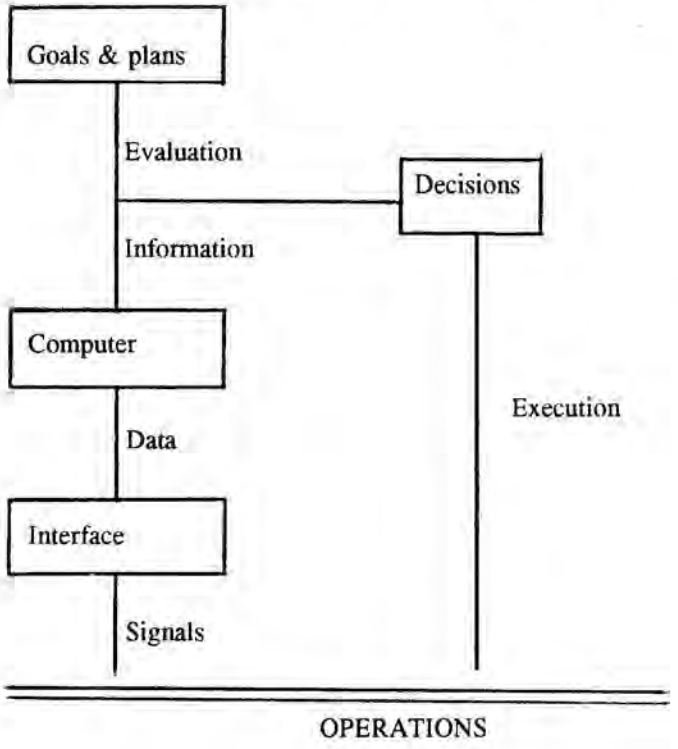

Figure 2: Information flow for management control

Various types of signals are being emitted from operations and activities. Such a signal may be about material shortage, or that costs of energy have risen or that deliveries to a customer have been delayed, etc. Thee signals are detected if there is a suitable interface, e.g. a reporting procedure. After processing the data in a

computer with the help of a suitable application model, the thus provided information is available to a decision maker.

In order to analyze the results of an operation, the information is compared with pre-set plans and reference values. The analysis can be made through the computer model or by the decision maker. In both situations, however, the signal interfaces ('reports') and the computer programs must be defined in accordance with the goals and plans in order to provide relevant information. The diagram in figure 2 will now be used to illustrate the three levels of computer support for management control.

3.1 Three levels of computer support for business operations

It is possible to discern three levels of IT use for business operations. The first level, which is also the most common, is characterized by traditional routines for invoicing, payroll, etc. This level is seldom of any controversy as it is easily adapted to existing practices and routines.

The second level uses data of the first level but combines data, rather than just process, in order to extract more information. The third level uses more advanced models for analysis. The three levels are discussed further and illustrated with cases below.

3.2 The first operational level: processing

At this level data is processed by the computer as input to administrative routines such as accounts receivable. Information is not compared with any pre-set plans or directives (figure 2) even if the structure is mostly prepared for such simple analysis. This is a typical processing application where the computer's ability to provide information for decision support is not explicitly utilized.

In a presentation on enterprise management in Namibia a striking example was given: a Namibian company is regularly collecting data on customer sales volumes and values. The company has, however, not realized the additional benefit in using this data to produce sales analysis on the most profitable products, the most interesting customers, etc.[4] Such simple analysis does not require any complex models or more information.

3.3 The second operational level: simple analysis

Simple analysis does not require an explicit articulation of the cause-effect relationship, i.e. there is no need to go beyond and ask why something happens. Sales analysis, characterizing the company's market pattern (who are the customers, when and what do they buy) does not need to know the mechanisms behind the customers' preference attitudes. Or in other words, the cause-effect relationship between customer and product does not need to be known in order to make the analysis.

The decision maker, as in figure 2, utilizes the information coming through the established channels and uses it for the preparation of invoices and other administrative documents. In comparing this information with even rudimentary plans, the business performance can be evaluated providing valuable management information. The following two examples illustrate how relatively simple it is to perform such analysis.

3.3.1 SOCA in Dakar, Senegal

SOCA is a diary and fruit farm outside Dakar in Senegal. The farm has its own cattle and produces diary products (milk and yoghurt) which represent 65 per cent of the turnover. Fruit juices represent the remaining 35 per cent. Products are transported and sold within the great-Dakar area.

As distribution costs are high, the company decided to concentrate the selling of its products through 5 major supermarkets in Dakar. After some time the company realized, however, that only a fraction of the potential customers ever visited supermarkets for shopping. It was therefore decided to go back to the previous but very costly distribution system through 650 outlets in the Dakar area. It thus became crucial to analyze the business situation in order to try to reduce distribution costs.

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[4]The presentation was given by professor W. Wresch at the AITEC conference in Cambridge, UK (September 94).

SOCA's general manager has been using a computerized accounting package for some years for financial reporting and control. But the accounting system has no functions for budget follow-up and for sales analysis regarding customers and products. It could therefore not serve as the business operating tool that the company needed to help reduce the increasing distribution costs.

The general manager therefore took the initiative to develop an additional computer programme that analyzed the daily sales figures per product for each of the 650 outlets. Indicators and trends gave information about profitable and less profitable sales outlets. As a result the company managed to reduce 650 outlets to 150 with the goal of a further reduction to ultimately 100 outlets for the company's products. The savings in cost and time have been significant, thanks to an efficient business analysis application.

3.3.2 Mokat Chemists Ltd. in Accra, Ghana

Mokat Chemists Ltd is a small pharmaceutic store in the outskirts of Accra in Ghana. The present managing director returned after several years in London where she worked in a pharmacy and became aware of the usefulness of computers for business analysis. Back in Accra, after she became the owner and managing director of the pharmacy, she decided to follow the computer strategy of her former UK employer, i.e. to use a computer not only for the more traditional administrative routines but for business analysis as well. One of the more significant administrative routines used in the UK could, however, not be used in Accra: to automatically print labels for medicine boxes was not economically feasible because of the high prices for plastic boxes!

The other significant application, however, turned out to be very useful: analysis of what products were sold, how many and when. This relatively simple stock control system allowed Mokat Chemists to concentrate on the high volume products, to identify seasonal variations in demand so that requirements from their most important customers (e.g. local hospital) can always be met. This is very much in line with recent business principles as displayed in for example the World Class Manufacturing concept.

3.4 The third operational level: advanced analysis

The third operational level for management support is also the most controversial one in developing contexts: the more complex the computer model is in relating effects to causes, the more sophisticated input data is needed.

Output from a computer, e.g. analysis results with diagrams and tables, is often credited with a considerable reliability. This is the case even if the reliability of input data can not be guaranteed. In advanced analysis this should always be questioned as long as the computer model involved may be of general nature but applied in a specific environment. As such analysis involves a manifold of parameters and relationships it is a complicated task both to identify essential signals from the operations, to capture these signals and to measure them by quantitative methods. A pre-condition for such analysis is therefore that the analysis model is articulated and developed close to the user, that the application is well known to the developer of the model and that the data available really supports the computer model.

The correspondence between reality and model is often very week and the real usefulness of such results are for practical reasons very limited. But also here there are exceptions as the following case from Zambia shows.

3.4.1 Village Industry Services in Lusaka, Zambia

VIS is a non-governmental organization with the mission to promote business development among micro-companies in the informal rural industry sector. The hammer-mill project is such a project where hammer-mills are lent to small local producers of maize-meal. In addition to the 260 hammer-mills lent to small rural enterprises, VIS has assisted in the setting up of local repair shops for maintenance of the mills. Substantial local business opportunities have been provided through the project.

In connection with the project, VIS has developed a computer based performance measuring system to evaluate the project from different aspects. 6 variables have been identified as particularly important to follow up, for example management performance and transport facilities. Through the system, the project management at VIS has the possibility of assessing and comparing the effective use of all 260 hammer mills, and to what extent they manage to create local jobs and develop local business in the rural areas. In this example, the model has been developed by those who know the problems thoroughly and can make the conversion between reality and computer model.

3.5 What do we learn from the cases?

The three cases above have a few very important things in common. The three companies make use of their computers as analysis tools, in addition to more traditional processing of data for administrative purposes. The decision makers are personally involved and committed in the adoption of these analysis applications as they are the primary users and beneficiaries of the results.

4. Conclusion

Information technology users in developing countries have, in the past, been exposed to operational problems due to technical and economic constraints as well as lack of skilled personnel. Although these hampering factors have improved considerably in many places, the problem of low IT utilization still remains. One of the reasons is the low creativity in the development of new application areas such as simple business analysis.

Business managers need to become aware of such analysis as tools for better competitiveness and business performance. Management training should therefore create such awareness. In doing so it is, however, imperative that the two types of analysis be clearly separated in order to avoid confusion and misuse. Simple analysis should be encouraged, advanced analysis should be cautioned against for the following reason:

Due to weak fit between models of (often) Western design and applications in Southern contexts, IT users are faced with contextual discrepancies. Such discrepancies may be in the wording and understanding of phenomena but also in the references to different value systems and to different concepts of rationality. Advanced analysis such as simulations may therefore lead to wrong results and provide misleading management support.

This caution is particularly relevant against ready made analysis packages where pre-designed models of cause-effect relationships make pretence of being generally valid. The effect of such advanced analysis in an inconvenient context may result in an 'as-if' syndrome: the analysis result is accepted as if the reality, assumed in the model, also correctly represents the actual reality.

Lately, ready made packages for simple business analysis have been developed. One of the systems has been developed by the United Nations Industrial Development Organization (UNIDO) for the purpose of the medium enterprises industry sector in developing countries[5]. The system does not make use of predefined models but monitors business and operations trends through graphical representation of input data.

Constraints to using IT for analysis seems to be stronger in government organizations and enterprises than in the private sector. It should therefore be easier to introduce simple analysis applications in private sector enterprises because of less institutional constraints. In particular small and medium enterprise managers should be sensitive to the business performance argument.

Enterprise performance means to meet both economic and non-economic objectives. But in spite of growing awareness worldwide among managers about total quality principles, about the importance of being responsive to market needs and about business control techniques, various reports claim that managers in many developing countries show low awareness in this respect. Upgrading of this management skill is essential for local enterprises to become competitive with foreign enterprises.

It is therefore of vital importance to use analysis to show how well economic and non-economic objectives have been met. Managers need to know both how to identify which parameters are to be analyzed and to interpret the results of the analysis in a consistent and creative way. Information technology and adequately developed software already play an important role in creating such awareness and building management competence in enterprises in developed countries.

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[5]The system has just been completed and is available through UNIDO. The name of the system is BEST, an acronym for Business Environment Strategic Tool-kit.

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Geographic information systems for development planning in India: Challenges and opportunities

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Abstract
GIS technology is increasingly being looked upon as an exciting tool in the context of governmental planning systems in developing countries. Despite rhetoric to the contrary, the impact of GIS has so far been very marginal to national processes of development. The Indian government seems to be in the process of making long-term commitments to using GIS for district administration. National initiatives are being conceptualised and implemented by different organisations including the National Informatics Centre (NIC), the Department of Science and Technology (DST), Department of Space (DOS) and the National Afforestation and Ecology Board (NAEB). These initiatives, which involve huge outlays of resources, have the potential to initiate large scale changes in district administration. For these changes to be productive, it is important that these initiatives are planned very carefully. A basis for this planning is provided by our experiences with the study of district level computerisation. In this paper we discuss four implications from our past experiences on GIS implementation and use in the future: i) institutional reforms which refer to the changes in institutional level practices that can be introduced to enable more effective introduction and use of GIS; ii) technological transitions which refer to the changes in the design and development of information technology (IT) for development planning; iii) human resources development which includes aspects of education, training and research; and iv) technical support which deals with issues of supporting the technical systems being established in district offices.

1. Introduction

Geographic Information Systems (GIS) is an application of information technology that is increasingly being looked upon as an exciting tool for promoting socio-economic growth in developing countries (Taylor, 1991). While there have been many forms of mapping systems available since the sixties and seventies, GIS technology has evolved in the industrialised countries of the West since the early eighties. Fletcher, Bretscheider, and Marchand (1992) have described GIS as the technology which has had the biggest impact on the thinking of managers in county departments in the United States. The results of a recent survey (Campbell & Masser, 1992) suggest that nearly 70 per cent of local government organisations in the UK have either purchased GIS technology or were planning to do so in the near future. Since the late eighties and early nineties this technology is becoming increasingly visible in some developing countries, for example in India and Thailand (Yeh, 1991). However, evidence of successful GIS applications is still limited. Taylor (1991) writes that despite rhetoric to the contrary, GIS is still very marginal to the processes of socio-economic development in the third world.

Investments in GIS present considerable economic and organisational risks. GISs are large systems that require major economic investments at the initial stages of implementation. The expenses required for developing the databases are enormous, and they constitute a large proportion of the overall GIS project cost. Early decisions made by implementors establish long term, irrevocable commitments. The organisational risks evolve from the potential of GIS to redefine existing ways of work. For example, its application in Indian district administration will require that planners conceptualise their resource allocation problems in geographical terms which is quite different from their present ways of working. The different departments which have historically worked in isolation will be expected to combine efforts to create and maintain horizontally integrated databases.

The Indian government is in the process of making large scale investments in GIS technology in the hope that GIS, along with remote sensing technology and Global Positioning Systems (GPS), will be the key technology to support planning, especially at the district level (Kasturirangan, 1994). This is a complex task, and presents planners with many different opportunities and challenges. The historical evolution of district level computerisation

in India provides an opportunity for GIS implementation since a basic infrastructure for computer applications is already in place. The challenge that faces those responsible for implementation is to move people away from existing systems and ways of thinking about problems to new ways as is required by GIS technology.

The objective of this paper is to first of all describe the historical context of district level computerisation in India. Second, to examine the current state of GIS development in the country. Finally, we attempt to apply some of the learning derived from our past experience of district level computerisation to develop implications which may be valuable for using GIS more effectively in district administration. Two streams of ongoing research are drawn upon to make these comments: i) one of the authors has been studying information technology implementation at the district level in India (mainly Gujarat and Karnataka) since 1988; ii) the other author has been studying issues in GIS implementation in India since early 1993. The historical context is examined in the next section. This is followed by a discussion of the status of GIS use in the country. Some implications for the use of GIS in district level planning are presented in the following section.

2. Historical context of district level computerisation in India

The historical context within which computerisation initiatives take place are important to understand because they define the conditions for implementation and help to shape the path of the technology in the organization (March & Sproull, 1991). In terms of time, the historical context of district level computerisation in India can be conceptualised in three stages:

1 the pre-processing stage (before 1987) which was characterised by the manual system of monitoring development programmes;
2 the data-processing stage (between 1987 and 1993) - the stage of the launch and use of computers in districts primarily for routine processing applications; and
3 the analysis stage (from 1993 to the current period) in which there has been a shift towards using computers for more analysis-oriented applications.

2.1 Pre-processing stage

In the 1950s and 1960s efforts were made to decentralise development planning functions to local functionaries (Curtis & Watson, 1986) and to introduce a system of democratic political decentralisation, popularly called the Panchayati Raj. It was envisaged that this system would foster the total development of rural areas under the umbrella of the Integrated Rural Development Programme (IRDP) (GOI, 1988a). However, this system has had limited impact in practice because no serious attempt was made by the central and state governments to entrust planning responsibilities to the local functionaries and politicians (Inamdar, 1985). Moreover, the rather hurried expansion of the IRDP to cover entire rural India meant that there was an obscuring of the objective of comprehensive micro-level planning. Instead, the IRDP was launched in 1978 as a programme that merely provided subsidy and credit to rural poor households for the purchase of an asset without linking these efforts to overall district planning.

The lack of synergy between special programmes targeted to the rural poor and overall district planning was further exacerbated by the physical separation of the two authorities responsible for planning at the district level. The district panchayat authority was responsible for overall district planning, while for the IRDP separate authorities called District Rural Development Agencies (DRDAs) were responsible. However, in some states such as Karnataka greater commitment was shown such that the total development planning function was kept under the jurisdiction of the district panchayat office.

In 1988, a study group constituted by the Planning Commission reported that the information infrastructure was found to be broadly decentralised at the state level with a number of central government organisations having being set up at that level to collect and compile data (GOI, 1988b). The majority of data collected on most sectors including income, expenditure and living standards was done so on a sample basis. Disaggregated and updated information at district and subdistrict levels was found to be unavailable. The study team also found a great deal of overlap between existing data collection mechanisms which led to duplication of efforts and inconsistencies of data. They attributed this to the absence of an integrated data management strategy.

Around this time, the central government recognised that computer-based information systems offered the possibility of providing integrated information-handling support for micro level planning. This led to the genesis

of various central government initiated efforts in the mid 1980s. First, the National Informatics Centre (NIC) launched the DISNIC system for overall district planning. The system comprised of a 27-sector database covering the various fields of district administration with a high speed telecom network which facilitated data interchange between administrative units (GOI, 1990). Second, the Department of Science and technology (DST) launched an interdisciplinary project called the Natural Resource Data Management System (NRDMS) in 1986 for generating area-specific profiles of natural resources and socio-economic parameters for micro-level planning. A third project called the Computerised Rural Information Systems Project (CRISP) was launched by the NIC with the objectives of improving the efficiency of report generation for the IRDP, and also for improving the overall effectiveness of local planning (GOI, 1987). These projects took the form of isolated projects without any overall strategy for the development of information systems for development planning. Nonetheless, these initiatives set the stage for the use of computers for data-processing applications.

2.2 Data processing stage

While the NRDMS system was adopted only on a pilot basis in selected districts, the DISNIC and CRISP projects were implemented in all 436 districts in the country. Madon (1993 a,b) identified four main factors which hampered the implementation of the DISNIC and CRISP systems in the period from 1988-91. First, the systems, though meant for micro-level planning, were implemented as centre initiated top-down efforts. In practice, these systems were designed uniformly and they failed to take account of different administrative set ups and data needs. Second, there was a lack of clear direction at the sub-national level as to who was responsible for managing the computerisation efforts. The lack of adequate communication between the NIC and the DRDA offices in the districts contributed to these problems. A third factor was the poor technical support for the CRISP project. In Gujarat, the physical separation between the NIC and DRDA offices hampered coordination and limited contact between the technically-competent local NIC office staff and the DRDA users. Hardware/software problems were often not adequately dealt with by the vendors resulting in DRDAs having to wait several weeks for assistance from state government personnel. In contrast, the Karnataka district administration structure was an integrated unit consisting of the local NIC staff physically located to serve the various user departments. Such a structure resulted in better coordination between the IT professionals and administrators. Fourth, the DRDA staff were novice computer users and had little idea of how computers could be beneficial in their daily tasks. The motivation to use the system was thus limited.

The problems faced during the first few years of the implementation of the DISNIC and the CRISP systems resulted in suboptimal usage of the technology. By the early 1990s, there was an increasing recognition at the state and district levels that the menu-driven systems designed and developed by the centre were not relevant to the needs of micro-level planning. In order to improve the situation, the district NIC staff were encouraged by the state government in Gujarat to interact with and develop systems for user departments according to particular requirements in their districts. Similarly, the state government in Gujarat empowered the local DRDA staff to develop applications for IRDP according to their own reporting requirements. In order to trigger district level operations, the orientation of computer training courses held at the state-level for district officers shifted away from teaching district administrators how to operate the menu driven system, towards educating them on the potential of IT and providing 'hands on' experience of application packages such as wordprocessing, spreadsheets and databases. This paved the way for a transition from non use of computers to its usage for routine report processing.

During the period from 1991 to 1993, computers were used to automate relatively simple but important tasks in various district departments. The district staff normally did the data entry in NIC developed formats using the locally available NIC infrastructure. The reports generated were then transmitted to the state and central offices over the NIC network. The situation was slightly different in the DRDAs where the staff had started designing their own applications. The new emphasis in training towards end-user computing had generated a considerable degree of self-learning and curiosity among the administrators. While word-processing was the most commonly used application, the computer was also quite routinely used for developing IRDP annual action plans and other monthly reports. Automation of these reporting functions led to prompter work using fewer people. Districts which had invested more time, effort and resources in developing localised applications naturally perceived computers to be useful to them. They were therefore more inclined to introduce innovative mechanisms for providing local technical support, training, and for developing new work procedures in their district to support the technology. While processing applications have improved the efficiency of district administration by giving local administrators the

flexibility to direct technology according to their local reporting needs, this did not lead to improved effectiveness of micro level planning. For example, automated reporting of rural development programmes has not led to improved standards of living in rural areas.

2.3 The analysis stage

From around 1993, districts which had started to use computers for routine reporting began to experiment with simple analysis applications. For example, a simple type of analysis application being developed in some DRDAs in Gujarat records names of IRDP beneficiaries and ordered them in terms of income levels, caste and occupation. A more complex level of analysis involves developing 'what if' statements to show how output varies with changes in variables. The use of such applications are currently under discussion in the two states being studied. The essence of these applications is to integrate the upliftment of individual rural households under IRDP with that total development of the district. For example, appropriate income-generating schemes can be suggested for a particular household, given the infrastructure and resources available in that area.

In Karnataka, limited success has been experienced in achieving this integration because the data on individual households for IRDP beneficiaries is not available for scrutiny by the District Panchayat authority. In order to rectify this, many districts have now started to compile beneficiary lists to be used along with the village infrastructure data that already exists in the district offices. In Gujarat state, where the physical separation between the DRDA and district panchayats has hindered such integration in the past, a special high powered committee was set up in 1992 to manage the transition towards an integrated information system for IRDP. This system includes a survey of all rural poor households from which the poorest families will then be selected for assistance. The data set includes a variety of indicators relating to income, consumption pattern, assets, and land-holdings. Each of these indicators will be weighted by districts according to their relative importance and then used as a surrogate for poverty. So far, each district in Gujarat has completed data entry for at least two blocks. Data is currently being collated by each district on the projected productivity of its most popular schemes, as well as on the availability of vital linkages needed for their implementation. Then, there is to be an overlay of two existing databases (beneficiary and scheme) onto a natural resources database. Without this overlay, the individual IRDP allocated schemes may require particular natural resources which do not exist.

In summary, the institutional set-up for development planning in India has resulted in poor coordination between the management of the IRDP and that of other district development projects. This fragmentation was a major factor that prevented usage of computers during the initial years of the project. Subsequent usage of computers for routine processing has been made possible because the local NIC and DRDA offices have been given some jurisdiction to develop processing applications according to local needs. More recently, there has been an attempt to integrate programmes directed at individual households with those dealing with overall planning, including natural resources data. In order to proceed with this integration, the government has perceived the necessity of using GIS technology in district administration. Since the early nineties, India has seen many GIS initiatives directed at development planning. The next section reviews the current status of some of these initiatives.

3. Current status of GIS in India

Since the late eighties and early nineties a number of GIS initiatives have been taken up in the government sector. Notable among these are those by the NIC, DST, Department of Space (DOS) and the National Afforestation and Ecology Board (NAEB). Another major player in the national scene is the Survey of India who have the mandate to establish the digital cartographic database for the country. There is also evidence that a host of government user agencies are trying to use GIS to address domain specific applications. Some of these user agencies include the forest wing of the Ministry of Environment and Forests, Census, Geological Survey of India, Town and Country Planning Organization, Bombay Metropolitan Development Authority and the Coast Guards. Some private sector firms are also using GIS as a tool for decision support. For example, Hindustan Lever uses GIS to plan distribution routes for their commodities in rural India. Recently, a national level Geomatics society was established with the objective of providing professionals interested in the issue of spatial location with a common platform for interaction. We now provide an overview of four of the national GIS initiatives which have been taken up by the NIC, DST, DOS and NAEB.

3.1 National Informatics Centre (NIC)

While the NIC has been working with computerisation in the government sector since the mid-eighties, their GIS initiative started in the early nineties. The impetus for this initiative seems to come from two primary factors:

1 the existence of a nationwide high-speed telecommunications network (NICNET) which made the marginal cost of overlaying GIS on it negligible, and thus an attractive proposition; and

2 the Director General, NIC, has a vision of the future which revolves around the use of modern technology including GIS and he has galvanised the NIC to take up GIS development on a mission mode.

The mission mode implies a long term vision with relatively little pressure to produce short term project deliverables. The larger objective is to sow some seeds of change with respect to thinking about geomatics in government organisations. An independent GIS division was established in the NIC office in 1992 and its current focus is upgrading the first version of their in-house GIS software developed in 1993. This second version is currently in the Beta testing stage and is expected to be released soon. The vision is that this in-house package will soon be available to all district NIC offices through the country over the network. Nodal centres of GIS expertise will be located at the state headquarters.

A NICNET information highway with speeds of up to 2.2 Mbps per node is in position in 15 cities and is expected to be expanded by 1995 to 70 cities (Sheshagiri, 1994). Also, by 1997, the NICNET is expected to be expanded to 6000 development blocks. NIC is using these 15 cities as their pilot sites where their in-house software can be used for some very simple applications involving the generation of thematic maps. In the next stage, software and hardware upgrades, for example changing over to 486 machines from the present 386 series, are expected to take place. Some preliminary training efforts have been initiated and some staff have been trained in GIS. In the future, these efforts are going to be intensified and NIC also plans to invite staff from other departments to attend training programmes. At present, the NIC has not put much emphasis on developing user awareness about GIS. The feeling is that such awareness-building should wait until basic computer literacy and simple analytic skills have become fully institutionalised amongst district administrators.

3.2 Department of Science and Technology (DST)

This GIS initiative has its genesis in the Natural Resources Data Management System (NRDMS) program which started in 1986. The focus of this effort was to develop natural resources profiles of different regions in the country. The GIS focus to this project was provided in the early nineties with the DST realising its potential of GIS in natural resources management. An important aspect of their efforts was the development of the GRAMS GIS software which was especially designed towards supporting the management of natural resources in the Indian context.

The vision for the NRDMS programme is primarily that of an R&D effort where the DST will take the project to a demonstration stage and then hand it over to the state authorities. Unlike the NIC effort which is targeting all districts in the country, the DST is working on a smaller scale in some 12 or 13 areas which correspond to the different agro-climatic zones in India. Typically, a DST district centre is located in a local engineering college and manned by 2-3 DST staff who are stationed there. DST provides the hardware and software (GRAMS) to this centre. A district level committee under the chairmanship of the Collector and including representatives from the DST, NIC and the various user departments are responsible for developing the GIS applications. The state contributes 25-30 per cent of the project cost and are also committed to sustaining the effort after the DST goes away. The results from the Karnataka experiment are being looked forward to with keen interest as that will provide the DST with a basis to plan further work.

3.3 Department of Space (DOS)

The DOS have a major role in the establishment of the National Natural Resources Monitoring System (NNRMS) - an all-encompassing management system for natural resources using data from remote sensing, socio-economic and other conventional surveys (Indian Society of Geomatics, 1993). At the behest of the Planning Commission, the DOS has taken up a major programme called the IMSD (Integrated Mission for Sustainable Development) which is being implemented by the ISRO (Indian Space Research Organization). Under this programme, they propose to undertake remote sensing based integrated land and water studies for 157 problem districts (45 per cent of India's geographical area), including an earlier set of 21 districts in which they had conducted pilot programmes (Kasturirangan, 1994). DOS is trying to develop natural resources profiles of about 20 districts in the country with

the objective of supporting decision-making related to sustainable development. This programme, in which GIS technology is expected to be an important tool, will also provide an impetus to the use of remotely sensed data being generated under the Indian space programme.

Another focus of the DOS initiative is the development of GIS software. They have collaborated with two software industry partners under Technology Transfer agreements to develop ISROGIS and GEOSPACE. ISROGIS is now commercially available on a variety of operating environments. GEOSPACE is a raster-based GIS package which is being used by different agencies.

3.4 National Afforestation and Ecology Board (NAEB)

The NAEB initiated ten pilot studies in January 1991, in collaboration with eight scientific institutions in the country, with a view to examining the potential of using GIS technology for land management and wasteland development applications. Eight of these ten projects were completed in early 1993 and then reviewed by the centre. It was then decided that the projects would be continued/extended to specific field situations. By early 1994, five of the eight original institutes submitted proposals for continuation of the projects and sanctions were accorded in April 1994. This second phase of the project, which is currently under progress, is of a two year duration.

3.5 Summary

Broadly, three categories of GIS players are visible on the national scene: the developers, the users, and the facilitators. The developers category includes organisations like the NIC, DST and DOS who are primarily involved in developing GIS software and using it for different purposes. Presently, the users category is primarily comprised of organisations such as the Census department and the Geological Survey of India who are trying to use software created by other developers for their specific application needs. However, the district administration is expected to become a very significant user of GIS in the future. The facilitators category includes vendors and other consultants who are providing software and also other support services to GIS users. Also included in this category are some non-governmental organisations (NGOs) who are tying to help government bodies with GIS implementation in districts.

The primary focus of most of these initiatives has been largely technical. For example, the NIC is concentrating on establishing a GIS infrastructure at the district level. The role of the DST is largely to provide a thrust to different technologies, for example, database organization and information processing. Similarly, the NAEB project is more concerned with demonstrating the utility of GIS technology applied to the management of wastelands. However, as these initiatives progress from the technology development phase to the next phase, where the objective is to actually have relevant authorities apply the technology to specific problems, social aspects assume central significance. Some of these aspects are: the existing work processes of the users, and how they may be influenced by adopting GIS; the hopes, expectations and fears people have about GIS; elements of education and training; and the different changes which have to be initiated in organisational structure and procedures in order to enable more effective utilisation of the technology. Another issue of importance with respect to these efforts is the need for the initiating organisations to communicate and share resources with each other. GIS applications become more cost-effective if they can use data that are already collected for some other purpose and then integrate that data with other previously unrelated datasets. In the absence of communication between participating organisations, such an integration becomes nearly impossible. In the next section we discuss how some of these issues can be addressed based on our learning from prior experiences with district level computerisation.

4. Implications of experience with computerisation on GIS use

In this section we discuss some of the implications that arise from our past experience with district level computerisation on the practice and use of GIS technology for district administration in the future. Four main implications are identified:

1 institutional reforms which refer to the changes in institutional level practices which can be introduced to enable more effective introduction and use of GIS;
2 technological transitions which refer to the changes in the design and development of IT for development planning;
3 human resources development (HRD) which includes aspects of education, training and research; and

4 technical support which deals with issues of supporting the technical systems being established in district offices.

4.1 Institutional reforms

From the point of view of applying GIS more effectively in district administration, some qualitative aspects of institutional changes are discussed. One relates to the need to impart more flexibility in the method of working. Madon (1993a) notes that a major constraint to the earlier computerisation efforts was the paternalistic style of authority which prevailed in the administration. This style was largely incompatible with the analysis applications because it threatened to replace authority based on hierarchy with authority based on expertise. The district was constrained in terms of norms from the centre, for example in terms of how beneficiaries were selected for the IRDP project. These rigidities tended to stifle micro-planning efforts which require local initiative and judgement in interpreting output related to individual households, schemes, village infrastructure and resources. Increased flexibility will need to be granted to enable local authorities to tackle more relevant problems in more appropriate ways.

Another factor relates to the need to impart more continuity in operations. The process of development and utilization of GIS is complex and takes a long time, for example the task of database creation can itself take 3-5 years. Given these circumstances, it is important to ensure that continuity is maintained in the implementation efforts over this period by developing an effective and sustainable partnership between the technology developers, users and facilitators. To ensure that these different actors are sensitive to the significant commitments of time and money that are required in the process, policy initiatives need to be taken which allow the development of core GIS groups in the districts and which ensure that people from these groups are not subject to frequent transfers.

Another issue deals with the need for having greater integration between the different GIS initiatives taking place in the country and also between the users involved in district administration. As discussed earlier, the NIC, DST, DOS, NAEB and other government agencies are each working individually towards the application of GIS technology for different aspects of district administration. While independent efforts foster creativity and multifaceted learning experiences, they can also involve some duplications in the use of time, money and other resources. Formal and informal means of communication between these agencies can help to make these initiatives more effective. According to Madon (1993a), the segmented form of administration in states likes Gujarat has contributed to data relevant to district planning being scattered among several agencies. GIS technology, by its very nature, creates a stronger need for different departments to interact more closely with each other. This interaction has to be fostered in a collegial environment through forums such as 'user groups' where different departments communicate with each other and learn through the sharing of experiences.

4.2 Technological transitions

Technological transitions reflect the process by which a system moves from a certain way of doing work to other ways. When new technology is interpreted as a continuation of existing technological capabilities, the transition becomes smoother as compared to the case where the change is seen to be a radical departure from existing capabilities (Sahay, 1993). Continuities of technology build upon an established base of knowledge whereas discontinuities require the creation of new knowledge before the transition can occur. In the context of using GIS for Indian district administration, we are talking about a potential discontinuous change involving a move to a predominantly map-based planning system that is supported by GIS from an existing system which is largely non-map based but which is becoming increasingly computer-supported. To make the uptake of GIS more effective, it is important to take steps that can smoothen these discontinuities to some extent.

Building awareness about GIS is fundamental in enabling smoother transitions. Planners are largely unaware about this relatively new technology and also about the long drawn-out and complex nature of the implementation task. Such awareness can help to develop and sustain participant interest over the long period when no tangible benefits are forthcoming from the system. The task of awareness building can be approached in different ways. First, by providing planners with demonstrations of working GIS applications that may have been developed by different research institutions. Second, by providing exposure to earlier forms of mapping systems such as CAD and Computer Vision that can also contribute to making smoother transitions because they introduce the user to the concept of spatial representations. Third, by monitoring the social interactions between users and developers. For

example, when a user is shown a system demonstration, he (she) can express both favourable and unfavourable reactions to it. If these responses are not documented in a systematic fashion, they get lost with time. Our past experience with district level computerisation shows that feedback from users is not systematically recorded. Such a database would provide a historical record of some of the social aspects of the project which could help develop awareness and a sense of continuity with past events. This is especially important in the context of district administration where frequent transfers of local staff are seen to seriously impede progress of the project.

Another important aspect of the transition to GIS relates to the systems of data management. It is extremely important to compile GIS databases that are relevant to the problem of micro-level planning and also which are compatible with existing systems such that the costs and the efforts of the changeover are marginal. This requires the development of data management strategies which includes the articulation of a vision of data needs and also the establishment of mechanisms to physically create the systems. This involves defining data responsibility, for example by identifying the custodian of data and by developing a memorandum of understanding between the different participants. As discussed earlier, there are multiple agencies involved with micro-level planning using GIS, and so a rigorous data management program will help to prevent redundancies in their data gathering efforts and also contribute to a more effective utilisation of time and financial resources. Joint teams comprising of people from these different developer and user agencies can try to address crucial but often neglected issues concerning data requirements, standards, cost-effective measures by which existing data can be converted to GIS format, and the relevance of data sets for local planners.

4.3 Human resources development (HRD)

Another bottleneck with the past computerisation efforts has been the limited demand for analysis by district officials. For example, district planning has been largely monitored on the basis of physical and financial progress with negligible consideration being given to qualitative performance. The task of planning has thus been viewed primarily as an impersonal and mechanical exercise. Another factor contributing to this lack of demand was that the departments had novice users, with a limited understanding of the potential of technology in their work. They saw the process of interacting with technology as an additional burden to their work, and were not motivated to learn about the advantages of using a computer. There was also the problem of qualified people being unwilling to work in remote district offices.

Given our past experiences with the extent and nature of HRD problems in computerisation, it is important to address issues related to manpower very seriously. Two issues relevant to this problem are as follows. First, who provides the impetus to this training effort. Second, the nature of the training strategy itself. A key finding from the experience of computerisation has been that innovations for analysis have to be initiated from the state government and below. The role of the state has been crucial in guiding the transition from non-usage of computers, to processing to analysis. The IRDP system is one of the many attempts by the state government in Gujarat to encourage the use of analytical applications. Similarly, the recent impetus for qualitative planning and monitoring of IRDP has also come from the state government and district officers rather that from the centre implying a bottom-up rather than top-down effort. The impetus for HRD around GIS could also be provided by the state level offices of the NIC, DST, and other user departments rather than from the centre. However, concurrent with the state impetus, it is also important to develop capability within the user departments to be able to guide the direct the use of technology in ways which are meaningful to their specific requirements. For example, the NAEB project can help to provide capability to the forest officers to use GIS in problems relating to management of wastelands such that these officers will be better equipped to interact with the local NIC staff in the effort to develop more locally-relevant applications. If similar projects are initiated in other user departments such as Soils, Planning and Agriculture, then the officials in these departments will be more aware of the potential of GIS and will therefore be in a better position to interact with systems developers.

Strategies formulated for HRD in GIS will need to be tailored towards the awareness and capability of local administrators as well as towards the state of maturity of GIS usage in the district. There are two forms of knowledge related to GIS: conceptual and operational (Sahay, 1993). Conceptual knowledge reflects the capability people have to think in spatial terms rather than the detailed software procedures, and involves developing understanding of geographical concepts related to topology, geo-referencing and geo-coding. This capability will allow the user to visualise problems in spatial terms and translate his/her need for geographical products into

workable GIS solutions. Operational knowledge relates to the procedural aspects of GIS, for example how digitizing is done, or how data is entered into the database or how reports are generated from the system. For the senior level district officials, conceptual knowledge is more important as it will provide the capability to articulate a vision for GIS use in their departments. Then, to translate these visions into workable applications, people are required at lower levels with operational knowledge. Knowledge requirements will also vary with the stage of maturity in terms of GIS use in the district. In the first stage, the primary focus is on the creation of datasets. The second stage involves the generation of simple thematic maps for demonstration purposes. The third stage involves analysis applications of different levels of sophistication; from simple overlaying of different themes to the more complex modelling and simulation exercises. The implementors have to understand the different mixes of operational and conceptual knowledge that are required as GIS use evolves through these stages.

4.4 Technical support

Poor technical support was identified as a key factor in the failure of the CRISP system in Gujarat. A reason identified for this failure was the physical separation of the DRDA and the NIC offices which created delays in obtaining support. An absence of local capability to deal with technical problems set up the need to obtain support from the centre which led to delays. In terms of GIS, the issue of technical support needs to be considered with great care because the technology is relatively new and complex.

The GIS developers are either government organisations such as DST, DOS or NIC, or private sector distributors of foreign companies. While the government organisations do not have the adequate infrastructure to provide technical support, the private sector distributors often do not give adequate importance to the issue of support. For example, in the NAEB sponsored GIS initiative, it was seen that vendor related problems had led to major delays in project implementation. The DST and the DOS are trying to outsource the marketing and support function to a private organization. Whether such an arrangement will lead to better support to users is yet to be seen.

The issue of support becomes more crucial as the systems are established in remote district locations which are harder to access, where there are relatively greater shortages of equipment and manpower resources, and where operating conditions are more trying. For example, frequent power failures may require the system to be constantly re-booted. Addressing the issue of technical support has to be considered carefully at the levels of the user and the developer. The measures at the user level includes a careful definition of hardware/software requirements, ensuring selection of appropriate software, and drawing up sensible support contracts with the vendors. At the level of the vendor, measures include efforts to understand in detail the needs of the user, and to approach the issue of GIS support in a manner that is radically different from how they currently provide support with respect to sales of other hardware and software. Firm support contracts between the user and the vendor can safeguard the interests of both parties. For example, in the NIC-HCL (hardware vendor) maintenance contract in the districts, there is a clause of financial penalty for every day the vendor delays in responding to a technical fault reported by the user. The NIC staff felt that this clause had greatly contributed to the much-improved levels of vendor support. The support contracts should include aspects other than system maintenance. For example, training and education is typically not given adequate importance in the 'request for proposals' or in the final order contract, and this could be addressed by carefully drafting these documents such that the vendor is legally bound to provide sustained GIS education, and the users make appropriate financial commitment towards enforcing the contract.

4.5 Summary

We have discussed some ways in which the process of GIS implementation for district planning can benefit from our learning with previous district level computerisation efforts. Taking the argument of Zuboff (1988) and Peterson (1991) we emphasise that the full benefits of GIS technology will not be achieved when it is merely applied to automating manual operations, but when it will provide additional information about the nature of district administration which will enable authorities to introduce new work practices. GIS technology is a tool which can provide additional insights into the task of development planning by enabling planners to have a visual representation about the impact of development programmes over time. This additional insight may force changes with respect to accountability. For example, a local politician or administrator may tell villagers that he (she) intends to commit

resources towards developing new roads in the district. However, a map of that area may subsequently reveal that no road was built.

5. Conclusions

The experience of district level computerisation in India provides both opportunities and challenges for the implementation of GIS technology. A valuable opportunity exists to learn from the successes and failures of the last eight years of experience with computer projects in India for district level computerisation. An important learning from the past has been that providing flexibility to local administrators to direct technology to their local needs has contributed significantly to the usage of computers. Providing this flexibility to administrative practices is both a challenging and complex task. While a broad vision about the role of technology needs to be articulated at higher levels in the administration, adequate flexibility has to be provided to the users at the level of the district to be able to apply GIS effectively for locally relevant problems. Some of the mechanisms to address these issues have been discussed in this paper which we hope will be useful to authorities contemplating the introduction of GIS for development planning in the future.

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The potential of information technology in the management of an African crisis: Computers and AIDS

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Abstract
The Acquired Immune Deficiency Syndrome (AIDS) presents a public health of immense magnitude in Africa. Figures taken from the World Health Organisation (WHO) reports show that viral seroprevalence rates (number of tests found to be HIV positive) among blood donors range from 4 to 18 per cent in major African cities. To manage the crisis of AIDS in Africa it is crucial to have accurate figures about seroprevalence rates. However, it is extremely difficult to do this at present because the social implications of being discovered to be HIV positive are so serious that people are reluctant to present themselves for testing. Thus testing is dependent upon volunteer groups such as pregnant women attending prenatal clinics and blood donors. The seroprevalence rates found among such groups may not give a true picture of what is happening in the population as a whole. Another problem associated with AIDS testing is the need to preserve anonymity and thus protect the patients being tested from undue persecution. Manual registers and codes which are currently used, for example, in Kenya have not always proved foolproof thus compounding the problem of obtaining volunteers for tests. Finally, the percentages shown above reflect the large amounts of data which would have to be maintained if AIDS was to be properly managed in African countries. We discuss the possibilities of using computers to assist in the three problems identified, by demonstrating how computers can help preserve donor anonymity and identifying a statistical technique which enables more accurate and efficient screening for AIDS while preserving anonymity.

1. Introduction

Acquired Immune Deficiency Syndrome (AIDS) is a serious condition that affects the human body's ability to fight infection, eventually resulting in the death on the infected individual due to opportunistic infections. AIDS is caused by a virus called Human Immunodeficiency Virus (HIV) which was first described in 1983. AIDS is a contagious disease and is spread through body fluids such as blood, semen and vaginal secretions, through sexual intercourse, transfusion of infected blood, unsterilised medical instruments such as needles, and from mothers to their children.

Current efforts by public health authorities in Kenya to control the spread of AIDS have been hampered by the fact that the prevalence of the disease in the general population is not known. The prevalence is the percentage of the general population who are infected with the disease. Moreover it has been difficult to obtain sufficient participation by individuals in screening programmes due to the social stigma and possible adverse economic consequences of being diagnosed with AIDS.

This problem is recognised by researchers. For example in a position paper describing the AISY AIDS information system (Ochuodho, et al., 1992) state:

> *AIDS and AIDS-related diseases are so sensitive and personalised issues that their computerised processing may make them suspect (especially) to the computer-illiterate clients. As a consequence an extra-level of data security and privacy is demanded of AIDS information systems. 'Readers' must be satisfied that no potentially incriminating information is held in the computer*, (p.2).

A related problem is the need to perform longitudinal (over time) studies of individuals who have undergone HIV tests. This involves keeping sensitive data about an individual, as well as his identity and contact, for follow-up studies thus increasing the risk of disclosure. In countries such as the United States of America where it is a legal requirement that all tested individuals must be informed of the their HIV test result, if it is possible to link the result with the individual, researchers have devised creative schemes to enable them to perform longitudinal studies on individuals who do not wish to know their test result for example (Avins, et al., 1992).

2. HIV testing in Kenya

The most common HIV tests performed in Kenya are the ELISA and Western Blot tests. Both of these tests check for the presence of HIV antibodies in human blood samples.

The government testing centre is the National AIDS Testing Centre (NATC) at the Kenya Medical Research Institute where tests are carried out for all referrals from government hospitals in Kenya, as well as public and private health centres. NATC will also test any individual on a walk-in basis for the payment of a small fee. Some of the AIDS counselling centres refer their clients to NATC for testing.

Apart NATC, tests are carried out privately at hospitals such as the Aga Khan Hospital and Nairobi Hospital. We were not able to identify all the places where HIV testing is taking place although NATC estimated that at the moment 60-70 per cent of all testing may take place privately. This has serious implications when it comes to the calculation of prevalence rates since the results of these tests are kept at the different testing centres which may not communicate their data to each other.

No mass AIDS screening has been performed in Kenya and the groups of people who are currently being tested fall into the categories shown in figure 1 below. We can broadly divide the test population into those who are tested because they have manifested symptoms of AIDS and those who are healthy but are tested for other reasons. The other categorisations are clear from the diagram except that perhaps an explanation is needed for the meaning of "'Power' Social". This category includes persons who are 'forced' to take a test to satisfy some social requirement such as to keep their job, travel to some country for business or educational purposes, or to obtain insurance, as opposed to those, for example, blood donors, who take a test for health reasons generally to protect others.

It is evident that the prevalence rates obtained for these categories may not reflect the national AIDS prevalence. In addition, as mentioned before, the data about the test results are kept in diverse testing centres so that no one testing centre can claim to have the whole picture. In the following section we will examine the problem of confidentiality which aggravates the difficulty of identifying the true AIDS prevalence rate.

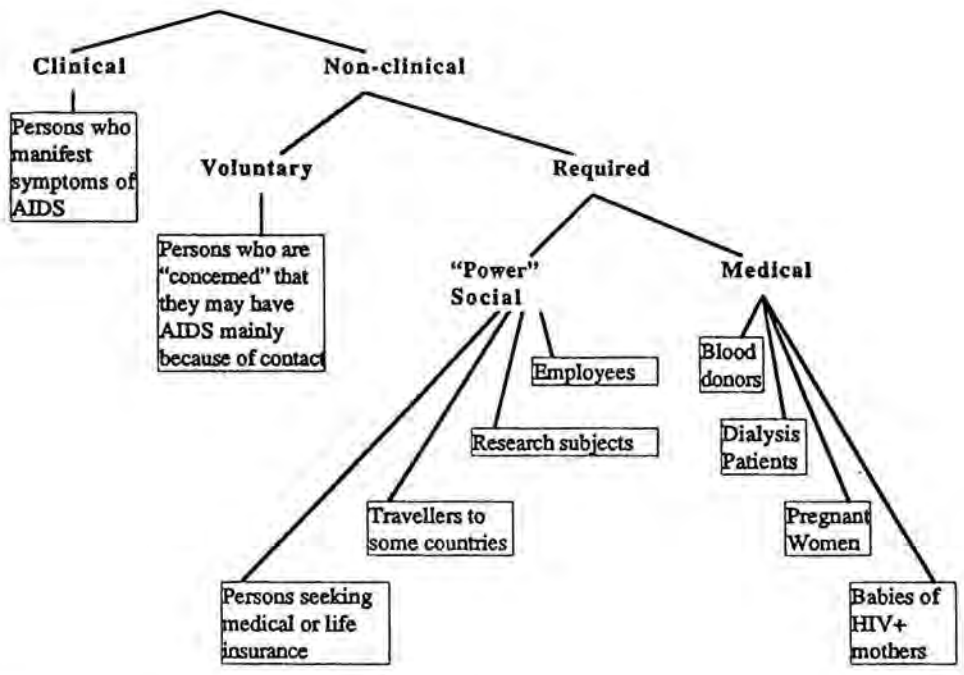

Figure 1: Categories of persons undergoing HIV tests

3. Confidentiality

There are a variety of reasons why it is desirable to maintain the confidentiality of HIV data. The discovery that a person is HIV seropositive (HIV+) may lead to serious social consequences such as the disruption of relationships with family and friends, loss of employment, denial of entry visas and denial of medical and life insurance as described in Hays, et al., (1992) and Songok, et al., (1994). Once a person has an HIV test there exists a possibility that their HIV status will become known to inadmissible persons. When this risk is minimised, it makes it more acceptable to undergo an HIV test. Our description of confidentiality is that the HIV status of a person should have an acceptably low risk of disclosure.

However, although we wish to achieve a low risk of disclosure with HIV data, it is the identity of the person which we wish to conceal. The other data associated with the person such as the test result, descriptive data such as their age, sex and so on may be crucial to the epidemiological study of AIDS and should thus be made available for research. Keeping the identity secret is known as anonymity. Some categories, seen in figure 1, above such as travellers are asked to provide documentary evidence of their HIV status. This also poses a challenge to the issue of confidentiality.

From figure 1 above we note that many of the people who have HIV tests are healthy. It thus seems even more critical that this category should receive protection from the adverse effects of having their HIV+ status disclosed when they may have many more productive years ahead (in some cases as much as 20 years).

3.1 Data security

Data security involves a class of techniques designed to restrict the privileges of certain classes of human users or computer programs to view (access), modify or process data held in a database. Some data security techniques are described below.

User identification enables the system to recognise a user and restrict the user to the functions allowed by his privilege status. Most computerised identification schemes are based on user names and secret passwords. The weaknesses of these schemes have been widely documented and in the future we may see other means of user identification such as voice recognition, face recognition or even chemical recognition schemes. Physical protection is another means of data security. This includes computerised data encryption which protects the whole database from access by individuals who are not cognizant of the decryption key. Physical checks such as locks and guards are also means of maintaining data security. An important issue is the means by which privileges are conferred to users and how these privileges are maintained. A careless scheme for giving or changing privileges can pose a great challenge to data security.

The choice of a particular data security method depends on the database facilities available to the implementor, the sensitivity of the data and the use of the database (i.e. archive or frequent access). Data encryption is a very reliable means of keeping data secure but it is not suitable for databases which are frequently accessed because of the cost of the decryption process. Another method of securing data is to enable users with limited privileges to have only a limited view of the database (ie. they are only allowed to access derived tables which include authorised attributes (Date, 1986)). As well as limiting access to attributes databases also need to limit the type of query that a user can implement since by judicious use of queries it is possible to deduce information which may not be visible in a certain view. Standard database texts such as Date (1986) and Ullman (1982) describe such query protection schemes.

3.2 Individual anonymity

While it is essential that the government provide a policy on confidentiality of HIV data, the procedures of various HIV test centres also need to be studied and advice given on how the procedures and data stores can be more confidential.

A study of one hospital showed that the problem of maintaining the anonymity of an HIV test patient within their current procedures is quite major. If we study the procedures which take place from the time the patient requests a test to the time that the test result is disclosed we will see that the confidentiality is low.

Figure 2 below is a representation of the sequence of events. A simple count shows that seven different people handle the patient of whom three know only that the person has had a test and four know the test result. If as in most cases the patient uses their real name as identification then four people apart from the patient definitely

know both the identity and the test result. In addition, note that the test result is stored in two different places and that another person, the laboratory administrator, has access to these records. We have characterised the simplest case of a walk-in patient, referrals require even more handling and storage of data, and there is much more risk of disclosure.

We follow with a suggested scheme which would not only improve confidentiality of HIV test data, but would also meet our aim of making the anonymous data available to epidemiology researchers. In this scheme, computerisation is crucial at least at some of the stages. The computer is necessary to facilitate encryption and coding of data. Figure 3 below describes the proposed HIV data individual anonymity scheme.

The central feature of the scheme is distributed storage of individual patient data, by storage of patient contact and history data as normal in hospitals - apart from their HIV status -, remote and encrypted storage of patient identity, and centralised storage of epidemiological patient data.

The distributed storage of patient data assists relevance. Each party who has interest in the HIV data is only provided with the information which they require and nothing extra. The test centre retains the identity of the patient but nothing else, not even the test result. The identity is retained so that in cases where a follow up is needed the national coding centre can send a follow-up request to the test centre who can then use their identity database to decode the request and contact the patient. A follow-up request does not of course mean that the patient is HIV+ since HIV seronegative (HIV-) patients may also be followed up for reasons of research. In cases where it becomes mandatory to know the HIV status of a person (requests should always originate at the National HIV database and essentially pass through the National Coding Centre), the test centre is the only organisation that can give the identity of the patient. If a patient has no wish to be ever identified an alias can be used by the Test Centre instead of the patient name and ID No.

The National Coding Centre provides an additional level of security. Here a new secret code is given to each patient (who of course at this stage is only identified by the Test Centre Code and Test Centre Patient Code). This new code is then associated with all the patient data elicited at the Test Centre and passed on to the National HIV Database. The Test Centre Code and Test Centre Patient Code remain at the Coding Centre where they are associated with the assigned secret code and kept in an encrypted file. Various schemes for efficient file encryption for computerised files are described in Meyer (1982).

The scheme described is superior to merely maintaining views, whose security is totally dependent on successful user identification data security schemes. It enables researchers to have access to all the relevant data while keeping identities secret. The main disadvantage of this scheme is its complexity and it would be necessary to perform a field test to see if the scheme was operationally viable. This is the next stage of this research.

Finally, the National HIV database would form a valuable repository of all HIV test data. The database would set the national policy on the format and contents of the data to be elicited from HIV test patients. It would also train Test Centre Counsellors to sympathetically and ethically obtain the information from patients. This database would be entirely anonymous with two, possibly three, levels of security for the patient identity. Prevalence rates would be much more reliable since all the data would be held at one place. In addition, with the improved anonymity, it is hoped that more categories of people would consider taking an HIV test and assisting HIV research studies.

The implementation of this scheme requires computer technology. A computer would be essential for the secret encoding and the encryption stage at the National Coding Centre. Computers could assist in the elicitation of patient information at the testing centres, and could also be used for storing the patient identity - which could even involve simple encryption schemes. Computers would also be effective for the realisation of the National HIV Database and for the analysis of HIV data. This scheme thus demonstrated a potential use of information technology in the management of HIV data in a socially responsible way.

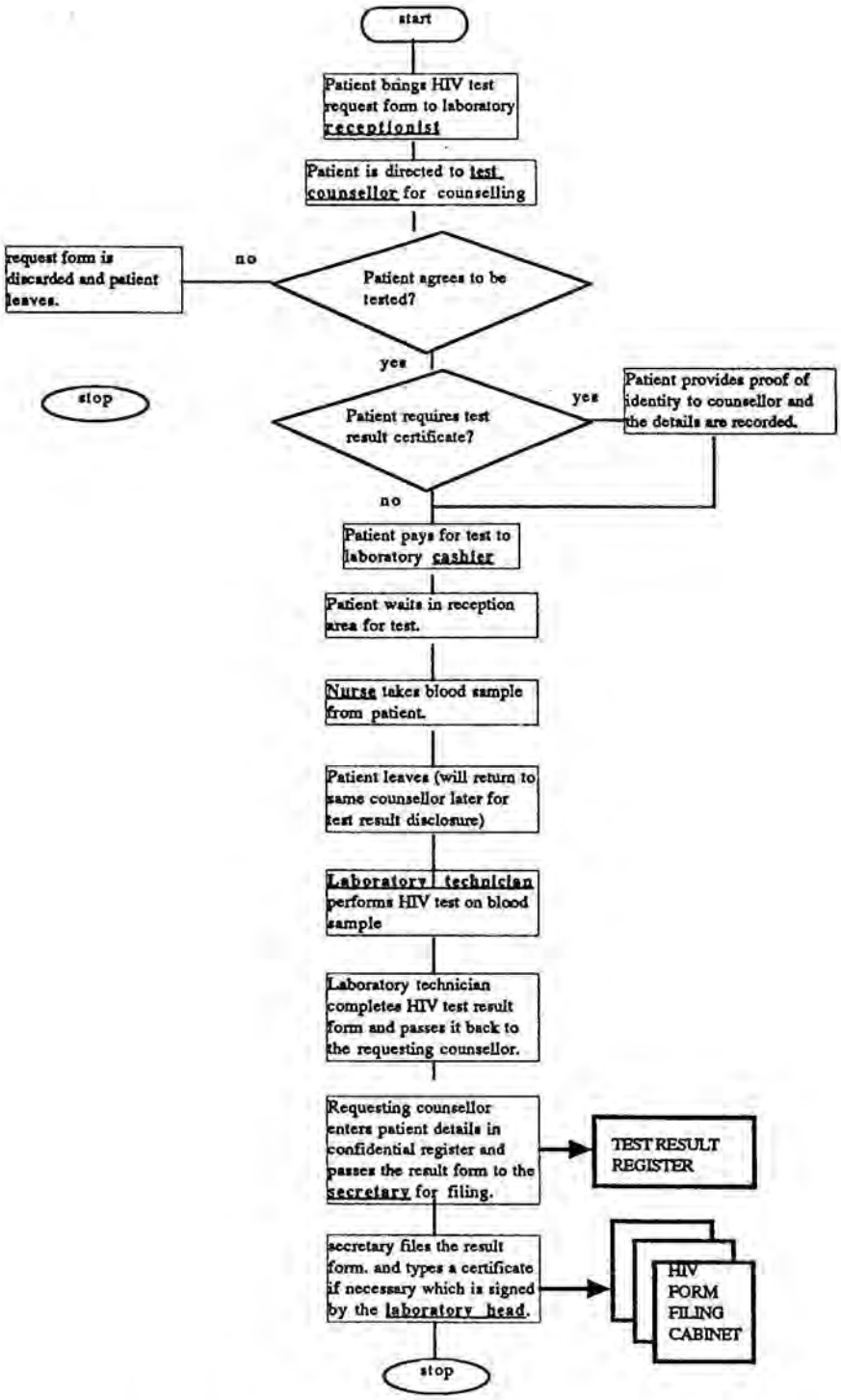

Figure 2: Sequence of events at an HIV testing centre

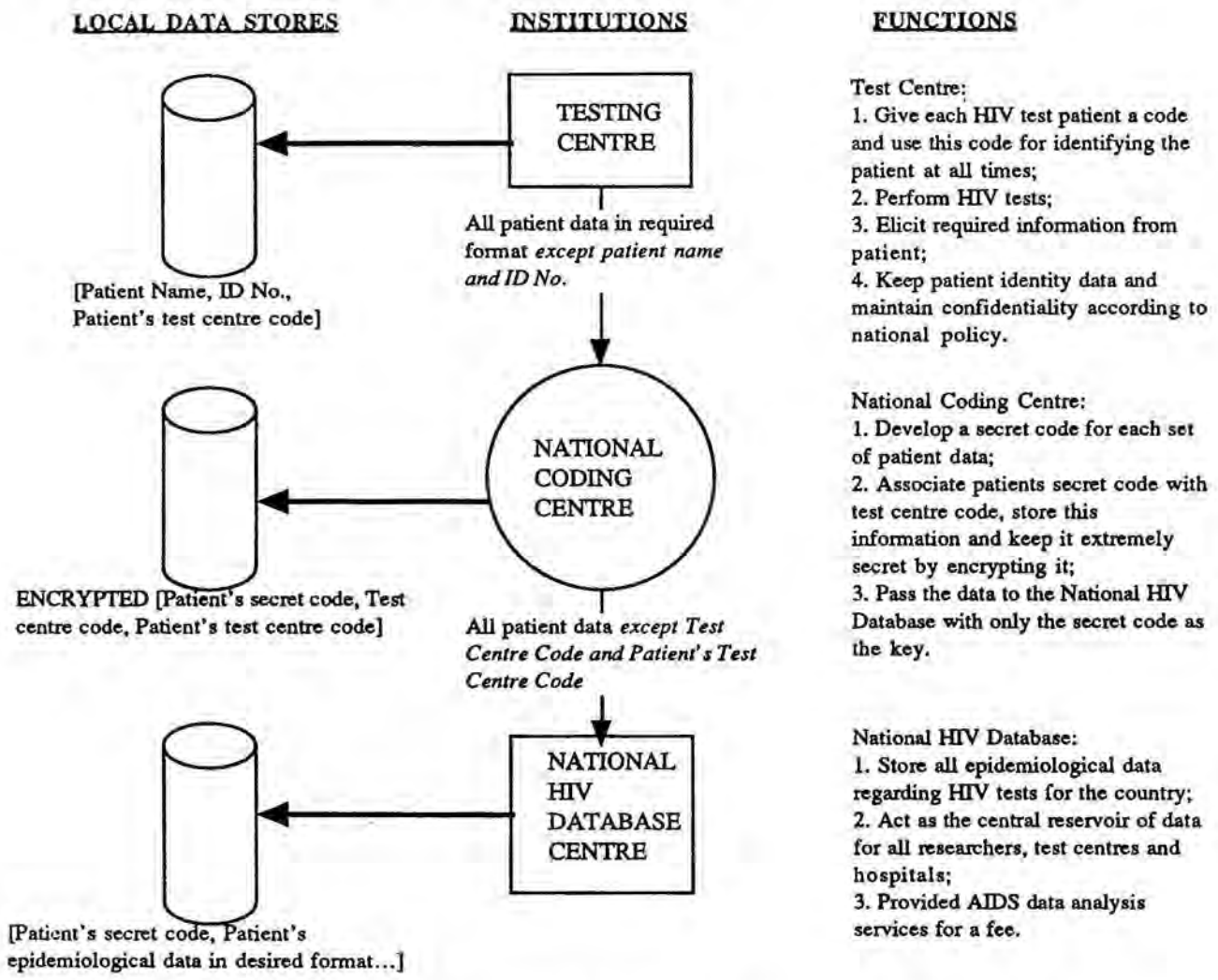

Figure 3: An improved HIV data storage scheme for individual anonymity

3.3 Group screening

The problem of maintaining individual anonymity can be assisted by group screening methods of testing.

Group screening entails testing blood samples in batches of size k in order to preserve individual anonymity while providing an accurate estimate of prevalence. Each batch is first given a screening test. Those classified are given a confirmatory test. If necessary, the infected individuals can be identified by repeatedly subdividing those batches that tested positive and retesting the positive subgroups until all the infected individuals are identified. Individual anonymity can still be preserved using the methods outlined above.

The group screening method was originally developed by Dortman (1943). His main objective was to minimise the number of tests needed to identify all carriers of a disease in a large population while assuming that the classification process was perfect. The refinements and generalisation of the Dortman model developed by Watson (1961), Mauro (1984), Odhiambo (1986) and others allow for classification errors in the screening model.

Gastwirth and Hammick (1988) have described a group testing model and procedure similar to group screening procedure outlined above. They have applied the procedure to estimate the prevalence of AIDS antibodies in blood donors while preserving individual anonymity of the blood donors.

We intend to develop group screening procedures, which in addition to providing reliable estimates for prevalence at minimum relative testing cost, will also provide screening information about individuals with controlled error misclassification. In particular we intend to investigate the performance of the group screening procedure as a model for screening the AIDS virus, in terms of the relative testing cost, the precision of the estimates of prevalence, the percentage of false positives and false negatives. In this way we should be able to characterise the sensitivity and reliability of the group screening method. These group screening procedures will initially be simulated using computer algorithms before field testing.

4. Conclusion

In this paper we have demonstrated the application of computer technology to a social problem: that of assisting researchers to obtain AIDS prevalence rates and perform other epidemiological studies using HIV test data by using a computer to intervene in several ways, that is:

1 Preserve individual anonymity and thus encourage more people to undergo HIV tests;
2 Centralise the storage of HIV test data, distribute non-essential individual data and maintain data security;
3 Provide analysis tools for researchers; and
4 Model group screening procedures through computer simulations and thus enable the development of a cost effective method of mass AIDS testing which preserves individual anonymity.

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The use of computer supported cooperative education to achieve development

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Abstract
With the enormous backlogs in education and training in South Africa there is no choice other than to identify alternative ways which could improve the existing educational situation. This paper describes a particular project in which the benefits accruing from Computer Supported Cooperative Education (CSCE) - a specific Information Technology (IT) intervention - is explored. It is of vital importance here to measure the contribution and through that, the success or failure of a CSCE intervention. To enable this, indicators were derived from specific problems experienced in South Africa. These indicators can guide educational investments towards CSCE. Two case studies are described which explore different aspects of CSCE, and in which some of the development indicators were measured. The eventual successful implementation of CSCE on a national basis would only be feasible with the support of educational policy makers. The work of this study will be used to propose a framework for the implementation of CSCE on a national basis.

1. Introduction

Educational problems are not likely to be solved by means of traditional remedies of spending more money, building more schools and training more teachers. It seems unlikely that large investments in the traditional system could significantly improve the existing situation. In contrast, an IT intervention could have far-reaching implications for an educational system with enormous backlogs.

2. The current educational situation in South Africa

The South African economy (Grobler et al., 1993) is characterized by economic underdevelopment and inhibited economic growth. One of the reasons for this situation is that the educational policy in South Africa has for long been short-sighted. During the following decades, education will have to be at the very top of the priority ranking in resource allocation. In fact this is already the case - South African spending on education and training has already reached the limits of what is possible in terms of the size of the national budget. During 1993, 21.4 per cent of the national budget was allocated to education with similar expenditures in earlier years. Compared to international standards, this figure is far too high. The worse part is that the return on this enormous (in terms of percentage of the budget) expenditure is not always convincing. Therefore, the South African situation demands a two-pronged approach: on the one hand the efficiency of investment in education must be increased, while on the other hand, and at the same time, the economic problem of increasing the gross national product has to be addressed.

A few figures about the level of education illustrate the urgency of an alternative in education and training in South Africa:

- 26 per cent of the population have no education, while 57 per cent have only five years of education;
- 38.2 per cent of the population are in the age bracket of 0 - 14 years compared to around 19 per cent in the same age bracket in developed countries; and
- 43 per cent of the population are younger than 20 years, and 28.7 per cent of the total population are of school-going age.

In addition to the above mentioned, the following shortcomings of the current educational system were also identified (WGTSET, 1993):

- A backlog of ca 39,000 classrooms;
- 25 per cent of black teachers only meet the official minimum qualification standard of matric (12 years of

secondary education) plus three years;
- Very high pupil/teacher and pupil/classroom ratios;
- The inadequacy (unqualified, underqualified and unsuitable qualifications) of teachers; and
- A 45 per cent black adult illiteracy rate.

The above are only some of the current educational shortcomings in South Africa but should make it clear that investment in human capital, other than just spending enormous amounts of money on the traditional system, is simply unavoidable.

Investment in human capital could be regarded as one of the preconditions for development. Investment in education also develops the individual and results in collective fulfilment of potential such as, for example, improvement in standards of living and a decrease in the rate of unemployment. Standards of living are largely derived from a person's ability to produce. This ability in turn, depends on physical capital and the quantity and quality of personal skills. Thus the importance of an appropriate educational system is obvious.

It is clear that South Africa needs a comprehensive educational goal aimed at initiating sustained economic growth. Unfortunately, there are no blueprints for economic prosperity through education. It remains a challenge to design an education package suited to the specific circumstances of the country.

3. Socio-economic realities in South Africa

In the past many people were misled by growth figures measured for South Africa. Many people considered South Africa to be a rich country. Measured by GDP per head ($3,050 in 1991, The Economist, 1993), for example, South Africa ranks alongside Hungary and some of the better-off Latin American economies. South Africans easily outperform their African neighbours. This was caused by the fact that a major part of growth as measured in South Africa has been due to its rich economic resources. Growth figures *per se* do not, however, reflect the whole picture, as they reflect growth only in the pure economic sense of the word and disregard the fact that a large part of the population did not benefit from these advantages.

Between 1981 and 1990, an average growth rate in real GNP of 1 per cent was registered. During the same time the annual rate of growth of the population exceeded 2 per cent. The net result of these factors was an increase in the unemployment rate and a decrease in the average per capita income. Job creation in South Africa (Gelb, 1991) dropped from 157,000 per annum (1960-1974) to 57,000 per annum (1974-1985). Dillman (1993) said that of the more than 400,000 job seekers who registered with the Department of Manpower in 1992, only 74,000 found employment. Stals (in The Economist, 1993), the governor of the Reserve Bank of South Africa, reckoned that in the second half of 1992 the economy produced 8 jobs for every 100 young people entering the labour market. In 1993, almost no job creation occurred and many were lost. These facts are very important when education and training initiatives are considered. It is one thing to create a better equipped labour force but another to find an economy able to absorb the additional workers. At the same time, in the long term, the economy needs a better equipped labour force for sustained growth.

On a macro-level, the following critical goals need urgent attention in the South African situation to ensure parallel development, i.e. economic and socio-economic development:

1 Creating an appropriate educational system for different segments of the population;
2 Supplying skills that meet current demand;
3 Creating jobs for a better skilled labour force;
4 Decreasing the unemployment level; and
5 Increasing the productivity level.

4. Computer supported cooperative education (CSCE)

Technology, in particular information technology, is an obvious tool to expedite the pursuit of the above goals. With problems in the education and training sector like, for example, enormous backlogs, availability to and/or affordability by everybody, low efficiency of investment and insignificant investment in human capital one must be very specific in selecting the type of information technology intervention. It is important to understand that the introduction of technology is a very delicate process and that technology itself cannot achieve anything without human agency. In the education and training environment this implies that any successful (information) technology intervention must involve the teacher. In fact, many technology interventions have been dismal failures because they

alienated the teachers instead of supporting and involving them.

It was therefore decided to focus in this study on CSCE - a particular type of information technology with the required attributes - and its application within the educational and training environment. In order to facilitate the description in the next paragraph, of case studies in which the application of CSCE were investigated, it is useful first to discuss the concepts of cooperative learning and of computer support thereof.

Various definitions of cooperative learning exist. Hilke (1990) defined cooperative learning as:

an organizational structure in which a group of students pursue academic goals through collaborative efforts. Students work together in small groups, draw on each others' strengths, and assist each other in completing the task. This method encourages supportive relationships, good communication skills and higher-level thinking abilities.

Cooperative learning is frequently referred to as a process that works (Devries & Slavin, 1978, quoted in Hamm & Adams, 1992). According to people like Slavin, Sharan, Kagan, and others (Hamm, et al., 1992), a collaborative approach has shown that it helps developing academic skills whilst promoting understanding and self-esteem. Collaboration implies giving students the opportunity to interact with fellow students which make them part of the social learning process and also prepares them better for the world of work.

Research done on cooperative learning suggests (Hamm, et al., 1992) that this approach to learning has, amongst others, the following advantages: it motivates students, increases academic performance, encourages active learning, increases respect for diversity, promotes literacy and language skills, helps prepare students for today's society and improves teacher effectiveness. For the diverse, poorly educated population of South Africa the above mentioned advantages can be very encouraging. Complementing factors to these advantages were found in more recent research done by Webb and Ziegler (quoted in Hamm et al., 1992) respectively. It was found that cooperative learning improves social relations between racially and culturally different students. After working in cooperative groups, all members became more accepting of classmates who were different. This obviously is very relevant in the post-apartheid situation in South Africa.

In CSCE, one adds computer support to groups to facilitate the learning process. This could be done in a variety of ways, by for example simply providing stand-alone components for each group. If, however, we support groups with networked computer facilities, we can set a natural diffusion process into motion. Through this diffusion process, group insight and achievement can cross classroom barriers, and local, national and international school barriers. The only prerequisite would be the availability of a local area network (LAN) in the school and a national wide area network (WAN) for schools. International access via Internet or other international WAN's would be the last step to create the classroom of the world. South Africa is in the fortunate position that there already exists a very healthy telecommunications infrastructure to support and enable CSCE as described above.

With CSCE one is not only advocating a more efficient learning process but also a more effective one. It is believed that this approach can, for the majority of learners, eventually open the world of learning and set them free on the road to inner development. This, in the final analysis, is what it is all about: to be, as Todaro (1989) has described it, emancipated:

from alienating material conditions of life and from social servitude to nature, ignorance, other people, misery, institutions, and dogmatic beliefs. Freedom involves the expanded range of choices for societies and their members together with the minimization of external constraints in the pursuit of .... development.

Arthur Lewis, as quoted by Todaro (op. cit.), stressed the relationship between economic growth and freedom from servitude when he concluded that "*the advantage of economic growth is not that wealth increases happiness but that it increases the range of human choice*".

In the next paragraph two case studies are described in which various aspects of CSCE were experimentally investigated.

5. Case studies

The purpose of the two case studies described below was to investigate in laboratory environments, various aspects of CSCE before making recommendations for implementing them in the current education and training environment. It was not to 'prove', statistically speaking, any particular result flowing from the use of cooperative learning or of computer supported cooperative learning.

5.1 Case study one

A cooperative learning environment (De Villiers et al., 1994) was implemented in a first-year course on the analysis of Information Systems at the University of Pretoria, using the Jigsaw cooperative learning method.

The case study was experienced positively by the students and created an awareness of the working world, where teamwork is essential. The use of expert groups is an important part of the Jigsaw cooperative learning environment. The expert groups were evaluated separately in this case study and can be judged to be effective. The following are some of the positive observations made during the case study: An enthusiasm amongst students about interacting with fellow students; an increased respect for diversity, implying that students learn to appreciate and respect one another; highly motivated students; increased self-confidence and self-esteem; an initial horizontal learning curve which later changed into a steep learning curve; a willingness to be successful; a growing interest in the subject; and an awareness of the working world. Very few negative observations emerged: No group cohesion in a few groups; preference for individual, lecture-driven studies; free-rider effect (although this applied to only about 7 per cent of the students); and too time-consuming from a student perspective.

Results from a questionnaire completed by students showed that students have high expectations about the co-operation between group members, as well as their own co-operation in a group. At the beginning of the case study, an unwillingness was observed amongst students to participate in group work. However, their attitude changed during the case study as they showed increasing willingness to express their thoughts, feelings and reactions to the rest of the group. Although the students were briefed about the purpose and advantages of group work, it is interesting to note, on conclusion of the case study, that the majority still believe that group work prepares them for the working world. It is also interesting that very few students remarked on the fact that group work may involve less work for them while most of them liked the social interaction in a group.

From this case study the researchers gained insight into group dynamics and the social skills involved in a cooperative learning environment. The results obtained from this research will be used to investigate how cooperative learning with computer support, as a specific information technology intervention, can contribute to the economic and socio-economic development of South Africa, through appropriate support of the education and training sector.

5.2 Case study two

A computer supported cooperative learning (CSCL) environment (Grobler, et al., 1994) was implemented using a group of school teachers structured around a course on word-processing. This case study was a follow-up on the previous case study. The main difference between the two case studies is that in the first case a cooperative learning environment was created and implemented while in the second one computer support was added to the cooperative learning environment. Cultural diversity and ethnic relations as specific elements of the cooperative learning environment were emphasized in the second case study. A comparison was made between the learning experience of individuals and groups, both using computer support. Results indicated an enthusiastic acceptance of the concept of group work by teachers who expressed a willingness to implement a cooperative learning approach in their schools if they were appropriately trained. This is of vital importance for the eventual successful contribution of CSCL to remove educational backlogs and through that to further development.

The main purpose of this case study was the comparison of individual learning approaches with learning approaches of groups, where both were supported by a computer. The case study was implemented on a group of teachers structured around a course on word-processing. Thirty percent of the teachers indicated that they have previously worked on a computer but it was mostly limited to their school administration system. From this information one can conclude that nearly the whole group started as computer illiterate.

The most striking result from the questionnaire completed by teachers (in the cooperative groups) was the fact that when they had problems assimilating the course material they received help from the group members. Another striking result was the idea that computer skills will open new opportunities in teachers' careers. This can be very positive from two points of view: firstly, it can be seen as providing increased self-esteem for teachers and, secondly, the strong possibility of the diffusion of this approach in the education and training sector as complementary to the traditional system.

Teachers continuously, throughout the questionnaire, expressed their enjoyment of the group work, the value of sharing ideas and feelings, and the motivation and support they experienced in their groups. The positive

experience of group work resulted in an average mark of 70.54 per cent for cooperative groups on the course in comparison with 54.69 per cent for the individuals. With the individual WordPerfect test there was an even bigger difference in marks: 54.24 per cent for cooperative groups in comparison with 34 per cent for the individual learners. The course dropout rate for individuals was 40 per cent compared to 24.24 per cent for the groups. It is clear from these results that in this case study the cooperative groups were more successful than the traditional individual learners. Results of this case study also indicated that teachers had a better understanding of the study material and that they learned quicker. This could shorten the educational life-cycle which could mean that more people can use the system over a shorter period.

One thing about group work that was disliked by many teachers was the pace of the group which was either too slow or too fast for them. It is therefore very important in the composition of groups to try and minimize the variation in ability to ensure a more effective group.

Apart from this, teachers were in general very positive about group work. However, it is difficult for them to see the long term benefits of such an approach in the school environment. This can be a result of the existing educational system. Most of these teachers have been a part of the traditional system for years and it is therefore very difficult for them to imagine any other approach to education. Nevertheless, teachers expressed a willingness to implement a cooperative learning approach in their schools if they were appropriately trained.

Any attempt to increase the efficiency of investment in education through technological support requires an indispensable component, the full support of teachers. Training in the technology used to support them only addresses part of the problem. If teachers do not accept the concept of technological support, no amount of training would make the particular attempt successful. This case study clearly showed teachers' enthusiasm about the concept of group work and of computer support thereof. This implies that one could expect positive results from employing CSCL to remove educational backlogs and to contribute towards development. This will be explored in a follow-up third case study.

6. Application opportunities

Before one can employ CSCE on a national basis throughout the educational system, one obviously needs to convince the educational policy makers that CSCE would indeed contribute towards development. This requires that one should be able to show, at least in a laboratory environment, measurable improvements in terms of the above parameters. To this end, an important part of the present study was aimed at the development of appropriate indicators to measure the success (from both an economic and a socio-economic point of view) of CSCE. These indicators will be described in a later publication.

The indicators were developed using a framework based on the work of Max-Neef et al., (1989) and were derived from specific problem situations in South Africa. In the described case studies, some of these indicators were measured and used to interpret the results of the case studies (these measurements are reported elsewhere (De Villiers et al., 1994); (Grobler et al., 1994)).

It is expected that on completion of the third case study, in which the development aspects accruing from CSCE will be specifically addressed, the measurement results of the indicators will clearly show that IT intervention could indeed contribute towards the solution of the serious educational problems of South Africa. This will then be used to develop a framework for the national deployment of CSCE in a supportive role within the educational system.

Experience in several developing countries has shown that the success of technology interventions is completely dependent on them being properly planned and managed. The above described work constitutes a contribution to the planning work that has to go into such an effort. Furthermore, proper management of a widely deployed system of CSCE would become possible if the indicators developed in this study were eventually employed to measure and thereby monitor the continuous success of the application of CSCE.

7. Conclusion

In this paper an overview was given of the educational and socio-economic situation in South Africa. This underlined the dire need for technology intervention to remove the current backlogs. It was argued that CSCE has the required attributes to be successful in supporting teachers and pupils in education and training. Two case studies were described in which aspects of CSCE were successfully investigated in laboratory conditions. The knowledge

gained through these case studies and the results of a further planned case study will be used to propose a framework for the implementation of CSCE on a national basis.

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Challenges in the use of information technology in preserving and accessing oral literature in Kenya

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Abstract
Literary scholars in Kenya have recognised that oral literature is a cultural heritage worth preserving and accessing. To this end, they have used traditional information technology to good effect. In today's world, however, modern information technology is available as an advanced complement of this traditional information technology. This paper examines challenges posed by the potential use of modern information technology to preserve and access oral literature in Kenya. In the process it discusses the place of oral literature in social development and challenges in use of traditional information technology to preserve and access oral literature.

1. Introduction

The nature as well as the function of information technology (IT) has been succinctly captured by Graham Taylor when he says that:

> *IT is the combination of computing and,telecommunications to obtain, process, store, transmit and output information in the form of voice, picture, words and numbers* (1986, p.15).

To the extent that information technology stores and outputs information, this technology can be used to preserve and access oral literature. We, however, need to know whether oral literature is worth preserving. To do this we need to understand its place in human society.

2. Oral literature and social development

In the course of our history, human beings have created art, which demonstrates that they are active creators and not passive consumers of culture. When this art outlives them and is preserved, it becomes a heritage for those born later. Examples of such a heritage includes cave paintings and pictures as well as writings done on ancient papyrus and tablets. In this respect, oral literature is such an art which, once preserved, becomes accessible to later generations. To this extent, two ancient stories have survived ancient Greece and become accessible to us because they were committed to writing. These are the Lliad and The Odyssey.

In Kenya, Kipury has stated that she collected Maasai oral literature because she was convinced that this literature would be lost to later generations if it was not preserved. To this end, she says that her study is "*an attempt to record, and hence preserve, part of the rich heritage of Maasai oral literature before it is completely forgotten*" (1983, p.vii). Such anxiety is understandable because oral literature normally flourishes during pre-literacy but wilts under literacy.

This being the case, oral literature captures and reflects a social moment that will never recur. In the process it captures both the beauty of and the insecurity rampant in the childhood of humanity. This insecurity is partly manifested in both an irrational fear of nature and a subjective interpretation of society which gave rise to a myriad of superstitions. In spite of this insecurity, however, the inhabitants of this childhood incessantly struggled against, and sought to harness, an awesome nature, as they, at the same time, struggled to cultivate culture in and build civilisation out of a primitive society. Oral literature reflects some of these struggles and, in the process, becomes an aesthetic record and a living testimony of human will to overcome mental and physical constraints put in the way by nature and society. To this extent oral literature is an ally to dynamic forces of social development.

In addition to capturing a unique social moment, oral literature reflects what the author has referred to as unique "*activities, demands, needs and yearnings of a people in their desire to understand phenomena like birth, death, love [and] marriage*", in the process and as a result, it "*apprehends and fulfils historical necessity*" (Kiiru,

1986, p.3). At the same time, since phenomena such as birth, death, love and marriage are universal in essence but particular in form, oral literature is a living demonstration that the experiences it explores and the yearnings it embodies are germane to humankind all over the world and down the ages.

In these circumstances, preserving oral literature accesses to us an art, whose loss would have been invaluable and irreplaceable if oral literature had disappeared alongside the society which created it and of which it was an aesthetic reflection. But thanks to preservation, oral literature has become our universal birthright because, even when it is preserved in its primary form, it can be accessed in forms, such as translation and dubbing, comprehensible to people separated from its creators by place, time or both. Such a rendition has accessed to us not only The Lliad and The Odyssey but also Kenyan oral literature.

We will now look at the two types of information technology which have been or can be used to preserve and access oral literature. For the sake of convenience, we will refer to these as traditional information technology and modern information technology.

3. Traditional information technology

Writing, audio recording and video rendition are three technologies in use today in preserving and accessing oral literature. Although these technologies are being used concurrently, they came into use in this consecutive order: written forms, audio renditions and visual images. We, therefore, have witnessed a technological revolution in preserving and accessing oral literature because these technologies have made it possible for an individual reader, listener or viewer to access a collective art in the privacy of a room. What is more, since oral literature can be translated from its primary language into other languages these technologies have made oral literature accessible to people separated from its primary state by distance, time or language.

However, these three technologies differ in the quality of preserving and accessing oral literature. These distinctions will become clear if we look at these technologies individually.

3.1 Written forms

From ancient times when tablets and papyrus were used as writing materials, to the medieval times when Johann Gutenberg invented the movable printing type the written word has become indivisible from human civilisation in preserving and accessing information.

With regard to preserving and accessing oral literature, the significance of this written word becomes evident when a researcher uses a pen or a typewriter and paper to maintain a relatively permanent record while a reader decodes the primary language in which this record is transcribed. Once this record has been translated, and transcribed into other languages, it becomes accessible to international audiences literate in these languages. In relation to this, some Kenyan oral literature, which was originally transcribed in indigenous languages, has now been translated into English, and, therefore, has become accessible nationally and internationally.

In spite of this accessibility, transcription and translation of oral literature is a laborious and time-consuming task. In addition, transcription calls on researchers to achieve an impossibility in preserving oral literature accurately because oral literature is a performance. Consequently, researchers striving for accuracy have to transcribe it as it is orally rendered. However, this is no easy task. On the one hand, if an oral artist slows down the rendering of a performance these researchers can preserve linguistic elements of a performance fairly accurately. In the process, however, this verbatim transcription compromises or loses the spontaneity of and the non-verbal elements in the performance. On the other hand, in an endeavour to capture this spontaneity, researchers can transcribe a text as the oral artist performs but without an attempt to render it verbatim because transcription cannot keep up speed with the spoken word. In effect, such researchers edit oral literature as it is enacted, recited or narrated and, in the process, render what, in their judgement, is the substance of the oral text.

Whatever method these researchers use to transcribe oral literature, they cut off its illiterate creators, who cannot access it once it is written down. Translation of this literature into alien languages only succeeds in widening the gulf between these creators and their literature. Consequently, writing as a form of traditional information technology of accessing oral literature is elitist.

3.2 Audio renditions

The spontaneity oral literature compromises or loses when it is transcribed is captured by an audio recording which

captures an audience's responses, an artist's speech rhythm or the sounds of instruments, such as the Kikuyu rattle. To this extent, an audio recording corresponds to a 'live' performance of oral literature because, as far as sound is concern, audio impression is faithful to a performance; the problem with this fidelity is that essential aspects of a performance and elements extraneous to oral literature are usually captured. Since these elements are not demanded by the literature, they have to be deleted - a cumbersome process.

Similar to the pen or typewriter and paper used in written forms of oral literature, the hardware and the software used in audio renditions of oral literature are cheap, accessible and convenient. In this regard, a cassette recorder is portable and uses readily available dry cells while audio tapes and cassettes are robust as they are easy to label, store and access.

But however robust this software is, it has a short 'shelf-life', needs careful handling and should be protected against dust - else irreparable damage will be done to irreplaceable data. At the same time, accessing data preserved on its track is cumbersome because such an access depends on how accurately listeners locate the required data from the tape counter.

Finally, audio renditions lose extra-linguistic elements, such as an artist's bodily movements and facial expressions, which are integral to a performance of oral literature, as Plato and Thomson have observed. Thus, Thomson quotes Plato narrating an oral artist's description of indivisibility of the artist's physical and emotional state from the poetry he recites: "*When I am describing something pitiful, my eyes fill with tears; when something terrible or strange, my hair stands on end and my heart throbs*" (1980, p.357). In 'Studies in Ancient Greek Society', Thomson relates a poetic 'outburst' to the bodily movements of a performer: "*As she spoke, she grew excited, her language became more fluent, more highly-coloured, rhythmical, melodious and her body swayed in a dreamy, cradle-like accompaniment*" (1961, p.437). These extra-linguistic aspects are lost in a sound recording.

3.3 Visual images

Moving visual images of oral literature overcome some of the limitations associated with the written word and the audio recording. This is because these images capture the spontaneity that is lost during transcription and the visual action that is lost in audio recording. Added to this is the convenience of the basic equipment needed for preserving oral literature: the video camera is portable while the video cassette is cheap. However, access of required data on a video cassette is cumbersome because the viewer has to depend on either notes based on the counter/timer or memory, as images speed by to locate the relevant material. At the same time, video cassette recorders and video display screens used to access oral literature are prohibitively expensive in Kenya and, even if they were relatively cheap, their use is circumscribed by electricity which is not available in most rural areas of the country.

3.4 Dynamics of traditional information technology

In spite of the limitations which we have outlined, traditional information technology, if exploited, can be used to preserve and access oral literature widely.

In regard to its written form, traditional information technology in the form of books, newspapers and magazines preserves and accesses oral literature in its primary state or through translation. In addition, the oral literature contained in these publications can be put on microfilms, which are both efficient as a backing storage and accessible once appropriate equipment is used. However, a drawback to the accessibility of oral literature through the written word is illiteracy because the audience this traditional information technology implies is literate.

In relation to its audio rendition, traditional information technology can widely disseminate oral literature via the national radio network, the Kenya Broadcasting Corporation (KBC). This radio station broadcasts in several indigenous languages, the official English and the national Kiswahili and, therefore, can nationally access oral literature in its primary and translated languages. Such a national dissemination will be possible because in Kenya radio receivers are cheap and their use is widespread.

Similarly, video images are accessible to a national audience via telecasts on the national television network, KBC-Television. Once these images are dubbed or subtitled, language barriers will be broken. Consequently, the preserved oral literature will be accessible to viewers who otherwise would be unable to understand the primary language used to preserve the oral literature. A problem in Kenya is the limited ownership of television sets compared to the extensive ownership of and accessibility to radio receivers.

In the end, there is a need to exhaust the existing output possibilities presented by traditional information

technology. The failure to effectively exploit these possibilities is, perhaps, one unstated impediment to adopting modern information technology as a complementary information technology to preserve and access oral literature. It is to the possibilities of this modern information technology that we now turn.

4. Modern information technology

Modern information technology comprises computerisation and telecommunications which, relative to traditional information technology, are prohibitively expensive in Kenya.

However, considering the rapid strides made in technology every day, this technology is becoming cheaper. The lowering of prices, as well as the continuous training of more and more information technology literate personnel, has made this technology accessible on the desk and on the lap.

In this section we will briefly discuss tapes, disks and optical storage systems as three primary types of backing storage and data communication and network systems useful in preserving and accessing oral literature.

4.1 Tapes and disks

Whatever their distinctions are, tapes and disks share one advantage over traditional information technology: speedy and direct access to data. They, therefore, overcome some of the limitations we noted in relation to audio renditions because, once data is keyed in, it is directly and speedily accessible. Disks access this data through a directory and index, which is a revolutionary leap from the counter used to locate material on audio tapes and cassettes. However, like audio tapes and cassettes, computer tapes and disks should be handled carefully in order to protect data. In this respect, the recording surface of a disk should not be touched and the disk should be neither bent nor exposed to dust. In addition, tapes and disks should not be secured, and back-up copies of programs made because, should the data on the original tracks be corrupted, keying in documents all over again is tiresome.

Although tapes and disks preserve and access data directly and speedily they are, in a manner of speaking, a form of transcription, which neither preserves nor accesses audio-visual dynamics integral to the 'literature' under discussion. At the same time, the modern information technology, to which tapes and disks are integral, is expensive relative to traditional information technology relating to written forms and audio renditions.

4.2 Optical storage systems

To an extent optical storage systems, comprising of optical disks and interactive video, preserve and access audio-visual dynamics of oral literature because the optical disk stores sound as well as pictures. In this way they overcome the limitations of tapes and disks. At the same time, they overcome the cumbersomeness of accessing material on the video cassette because, in Taylor's words:

> *Computer control enables rapid random access (unlike video tape) and interactive viewing according to individual need. ... Control software allows the user to programme the disk reader to search for particular video frames or to control sound output.* (1986, p.51)

Their advantages notwithstanding, optical storage systems are expensive.

4.3 Data communications and networks

Data communication and network systems open up revolutionary opportunities and possibilities of preserving and accessing oral literature on a wide scale. Data communication or network systems can preserve oral literature on and access it from a database on a national scale speedily and directly. While such access is somewhat similar to broadcasts, which have been centrally beamed to schools in Kenya since the 1960s and whose timetable is national and fixed, it would have an advantage over broadcasts because one can access oral literature when one requires it.

In addition, such a national data communication and network system opens up possibilities of developing educational and cultural material derived from oral literature. Once preserved, this material is accessible through a central computer or interconnected computers. This is material students can easily identify with because it is derived from their environment - past and present. In the process, the students will learn that their forbearers created a splendid culture, which was a consequence of and an impetus to social development. In this way, the students will be challenged to become creators of culture and not indiscriminate consumers of cultures they hardly identify with.

The immense pedagogical opportunities and possibilities opened up by data communication and network systems notwithstanding, this information technology is an expensive investment. At the same time, the dire

consequences of relying on a central/national database means that no data can be accessed from it should it break down - an occurrence that can be obviated through an installation of regional data communication and network systems.

5. Challenges of modern information technology

We now turn to challenges posed by the use of modern information technology to preserve and access oral literature. As we do so we should bear in mind Van Ryckeghem's caution that "*information technologies are not to be considered as magic devices*" (1992, p.48), and Avgerou and Land's observation that technology "*is appropriate only to the extent that it has a chance of furthering some national objectives*" (1992, p.32).

5.1 Justification

A fundamental issue needs to be addressed: a need to develop a sound theoretical justification for using modern information technology to preserve and access a primitive art form. This justification is particularly necessary if we bear in mind that modern information technology has been designed and developed to cater for sophisticated needs of an industrial society.

In so far as we perceive oral literature as a means of promoting backwardness or romanticising illiteracy we will to a similar extent find it difficult to justify the use of modern information technology to preserve, let alone access it. In other words, it would be pointless to employ modern information technology to preserve and access what it is the very antithesis of: backwardness and illiteracy.

Our challenge, therefore, is to expose educated hypocrites who may implicitly promote backwardness and romanticise illiteracy under a guise of preserving and accessing oral literature and a ruse of returning to our roots. In the process these people would forget that oral literature is an embodiment of progress and humanism, and, therefore, is central in revealing the human spirit without which social development would not be thinkable. Consequently, an appreciation of this centrality of the human being to social development calls upon us to study the place of technology in human culture so that we may understand how technology ameliorates man's poor state. Such a study is relevant because hardly any studies have been carried out in Kenya relating to the use of modern information technology in preserving and accessing literature.

5.2 Researchers

Modern information technology, being imported, is not only novel but also foreign to literary researchers in Kenya. To this extent, and in circumstances where it might be perceived as alien, its introduction or adoption has to contend with possible conservatism ingrained in researchers by traditional information technology.

Coupled with this perception is a possible technophobia arising out of a possible feeling by humanities-based researchers - the backbone of studies in oral literature -that modern information technology is computer wizardry designed and developed by scientists to dazzle computer illiterates.

The effect of such an attitude will be a resistance to accept modern information technology to preserve and access oral literature. In the same breath, researchers ill-disposed towards modern information technology can build up their arsenal against its adoption by pointing out that it is traditional information technology with which they are familiar and which they have tested and found workable. Indeed, such researchers will hardly discuss strengths and weaknesses of using traditional information technology to preserve and access oral literature but will use it without any apparent critical examination or theoretical justification.

In Kenya, Akivaga and Odaga have not taken traditional information technology for granted but have discussed some its relations to research into oral literature (1983, pp.6-7; 127-31). However, a number of researchers in Kenya hardly examine this relationship but seem to take for granted the use of traditional information technology to preserve and access oral literature. In this respect, Kipury talks about merely "*collecting some of the narratives*" (1983, p.vii) in 'Oral Literature of the Maasai' while Mwangi merely says that she employed a tape recorder "*to very good effect*" (1983, p.ix) in collecting her Kikuyu folktales. Kabira and Adagala briefly talk about fieldwork as "*the source of materials which can then be listened to, if recorded; or read, if written*" (1985, p.ix) while for Kabira and Mutahi "*the field becomes not only a source of material but in the process of data collection, the researchers become educated*" (1988, p.54). Briefly mentioning the traditional information technology he employed in his collection of Akamba stories, Mbiti says that he "*personally recorded some of them as they were*

told by various people" but "*was also assisted by pupils, students and teachers in different parts of Ukambani, who wrote down the stories as they were narrated after which they sold them to me*" (1984, p.vi). Similarly, in Ndai and Gichandi Pick merely says that at his request a rattle player "*wrote down the original text of the poem of 150 stanzas*" (1973, p.150). The translation of Kenyan oral literature into English is briefly mentioned by Mwangi (1983, p.ix) and Mirimo (1988, p.iii) while Kabira and Mutahi point out limitations of transcription by saying that "*any publication of oral literature (sic) material presents only part of the total performance which is presented in language form*" (1988, p.2).

However, today's researchers who seem to take traditional information technology for granted are the very people who will be directly - at least initially - involved in the use of modern information technology to preserve and access oral literature. As a result, the challenge is to make them feel at home with sophisticated electronic systems should they be technophobic and aware of advantages accruing to an adoption of modern information technology should they be conservative. Above all, it is important to stress to them that traditional and modern information technologies are complementary, but not antagonistic nor mutually exclusive.

5.3 Technical constraints

Modern information technology, which is inexpensive and portable compared to both the first massive computers and contemporary powerful personal computers, is now available. Despite these advances, however, it is principally used in business and offices. This is because it was initially designed for foreign industrial economies and subsequently introduced by subsidiaries of multinationals in the modern business and public sectors in Kenya. Consequently, researchers intending to use it to preserve and access oral literature need to adapt it to the task at hand.

At the same time, in an age when industrial nations are a primary source of and inordinately control information disseminated in the 'global village,' what say would Kenya have over a global dissemination of its oral literature? Considering this constraint, we can conclude that the audience data communication and networks system in Kenya have to capture in the foreseeable future is national. This then calls for a development of software which preserves and accesses culturally relevant data, such as oral literature.

5.4 Elitism

In Kenya, modern information technology caters for an urban coterie. At the same time, modern information technology is a sophisticated electronic system which is operated and maintained by a specialised corps. To this extent it is elitist cutting off a vast rural based population which, together with vast sections of the educated population, is illiterate in modern information technology.

The social danger of this scenario is that the use of modern information technology can be perceived as, and even accused of, accentuating, instead of blurring, distinctions between people literate and illiterate in modern information technology and dichotomies between town and country. This is especially so in research into oral literature where modern information technology will be used by a coterie of academic researchers to preserve oral literature from illiterate 'sources', but access it to computer-literates.

In the end, the issue will not be a mere adoption of modern information technology. Instead, the question will be: should we ensure that the vast population is educated to a level where it is a well-disposed recipient of information technology? This is food for thought.

5.5 Context

The socio-politico-economic environment is a central variable with regard to the use of modern information technology. This context is important especially when or if governments do not perceive modern information technology "*first and foremost as an essential factor of a country's economic development*" to use Okot-Uma's words (1992, p.17). We should add to such apprehension, fears expressed that a consequence of using sophisticated electronic systems will cause widespread unemployment or loss of manual jobs.

In such circumstances, the use of modern information technology in preserving and accessing oral literature will have to contend with considerable resistance. Add to this resistance contextual priorities: to what extent is modern information technology a priority in Kenya which is reeling under pressures of feeding its people and making endeavours to industrialise? At the same time, how high up do preserving and accessing oral literature rate

as a priority in Kenya in which literature, both oral and written, comprises a peripheral section in the secondary school English syllabus?

Once more this is not a light issue because when some scholars discuss information technology and culture what they appear to have in mind is the cultural context within which modern information technology should operate but not its use in preserving and accessing cultural heritage, to which oral literature is indivisible. Such thinking of culture as contextual and not textual is discernible in a statement made by Van Ryckeghem:

> *The question at stake is not whether technology determines culture or culture determines technology but whether and to which extent a degree of mutual adaptation is possible and how eventually change can be monitored. In this perspective, the failure of many technology implementations can be partly ascribed to conflicting values, habits and organisations.* (1992, p.44)

6. Conclusion

Bearing in mind the statement by Avgerou and Land that "*Technology can never be an end in itself. It is appropriate only to the extent that it has a chance of furthering some national objectives*" (1992, p.32), let us acknowledge possibilities opened up by modern information technology to preserve and access oral literature. Depending on what end we put it, this modern information technology will then achieve what technology has achieved in human history: act as a catalyst in speeding up processes to develop society and harness nature for our good - if we only understand what this good is. After all, this is what we ask of technology: to be an efficient tool in the service of generic man.

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Opportunities for information technology in enhancing socio-economic development of a developing country

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Abstract
Information Technology (IT) has greatly enhanced the economies and social conditions of industrialised countries. Most developing countries (DCs) are keen to exploit the potential benefits of increased productivity, efficiency and effectiveness that are associated with IT. However, the successes of industrialised countries have been difficult to replicate. While the level of success through IT may vary from country to county within the DCs, it is clear that the only way forward is to examine this technology carefully and adapt it to the countries' needs. This paper examines the nature of information flow in a typical DC, and discusses how IT can be used to facilitate the analysis and dissemination of this information in order to enhance socio-economic development. The experiences and recommendations developed can be useful to other DCs as well.

1. Introduction

Development allows people to lead lives of dignity and fulfilment. With development people overcome major huddles and remove difficulties that make life to be one of toil and hardship (South Commission, 1990). Information is necessary for development. Accurate and timely information provides a competitive edge to an individual, allows people to be more effective, and increases the efficiency of organisations. In this way, information becomes catalytic to the development of the country as a whole.

The relationship between information and development is symbiotic. Social development leads to increased information use and demand, while judicious use of information accelerates social development. The importance of information, especially in our world today, has been widely acknowledged: *"Information has always been a source of power and control, but never more so than in the modern world. Individuals and governments are using it to gain political and economic advantage"* (Hawkridge, 1991). Analysts today agree that a principal source of economic development is the production and consumption of information (Carnoy, et al., 1987), and this will increasingly become a product with significant economic value.

Until recently, much of the information in an organisation was treated as sacrosanct; availed only to a privileged few, usually those in power. As the volume of information increased, however, new thinking and attitudes were necessary. Organisations needed to provide more information for their subjects to work better and the organisations to be more competitive. By 1948, it became apparent that scientific techniques were necessary to address the problem of information needs. The Royal Science of London, brought together for the first time an international scientific conference at which a number of research papers were presented. The impetus created continued to grow and in 1958 the United States National Science Foundation held another international conference which was a great success (Vickery & Vickery, 1992). As research and knowledge in the field progressively grew, the Annual Review and Information Science and Technology was formed and it was decided to review progress each year, beginning 1966. Considerable work had been done by 1970 as revealed in a comprehensive survey by Saracevic et al., (1970). As far back as 1976, UNESCO started to actively promote the concept of National Information Systems (NATIS) where one of the major objectives is:

> *To ensure that all engaged in political, economic, scientific, social and cultural activities receive the necessary information enabling them to render their fullest contributions to the whole country* (UNESCO, 1976).

Today, information has been accepted as a vital resource as aptly described by the United States National Commission on Libraries and Information Science:

The right information provided when it is needed, in the form in which it is needed, improves the ability of an individual, a business, a government agency, or some other kind of organisation, to make informed decisions and achieve particular goals. (Mohammed, 1986)

The processing and dissemination of information can be greatly facilitated by use of computers. Indeed it is the merging of information processing and computers that has ushered in the new era of information technology (Kiangi, 1994c). IT, especially computer technology, entered the economies of industrial nations rapidly and widely. Through them developed nations exercise greater control over their competitors. Increased efficiency in the provision of services as well as labour-saving productivity gains in production have been achieved.

While IT offers a wide range of opportunities which the industrial nations have already tapped to their advantage, most developing nations are still waking up to realise what IT can offer. A cursory outlook on the responses of DCs to this new technology reveal a mixed bag of reactions.

A number of DCs are aware of the incoming era of IT but have failed to respond decorously. In most such countries, there are no policies to enhance the acquisition of IT, while computer hardware and software are acquired haphazardly through the efforts of individuals whose technical know-how is limited. The result is that there is no assurance of after sales services to computer users. Individuals who venture into buying computers end up dismally disappointed (Kiangi, 1994a).

Some DCs have noted what is happening in the developed countries with great admiration. Full of enthusiasm, they jumped into the bandwagon without much preparation. Most of these learn bitter lessons. Arab countries learnt the dangers of cultural invasion that comes with IT (UNESCO, 1985). Some IT systems implemented in DCs introduced more problems (Spiro, 1988), while others were vehemently resisted by the people (Akinyemi, 1986).

Yet another group of DCs saw the wind of change and forcefully opposed it. They too learnt bitter lessons. Tanzania, for example, severely restricted imports of computers up to 1985 (Hawkridge, 1991), and paid the price as indicated by complaints of poor communication services and poor information systems (Rwegayura, 1988). Tanzania is realising now, perhaps too late, that it needs IT to upgrade services and business.

From this brief discourse it is clear that most developing nations are lagging behind in IT. It is also evident that the solution for developing nations is not to ignore this new technology, neither is it to resist the change, nor does the solution lie in taking the leap in the dark, hoping that the leap will be a leap in the right direction.

This paper argues that DCs need not be left out. By carefully measuring the stakes, and strategically planning all IT issues, they too can reap the benefits from this technology. "*We must take the bull by the horn and face the situation squarely. We must examine carefully this new technology and plan how it can be adopted, exploited and enhanced to our advantage*" (Kiangi, 1994a).

This paper reviews the results of surveys conducted in Namibia to establish some basic information needs of the Namibian society. By identifying these basic needs, resources can be directed to those areas most needed or most in need. Information systems are exceedingly complex. Their nature and structure are influenced by many factors including culture, politics, technology, and more others. While these aspects have been widely researched individually, this study takes a more generic approach that views the situation in a wholistic sense. This way we hope to be able to underscore some basic information needs that cut across cultures and social structures. The field of information science is a precipitation of both theory and empirical findings. This is an empirical study, where some conclusions are drawn as to how IT can be used to facilitate information dissemination within and across various sections of the society. It is believed that what the surveys have revealed is typical of any DC, and therefore, the conclusions and recommendations developed here are believed to be valid in other DCs as well.

2. The status of IT in Namabia

2.1 Background

Namibia became independent in 1990. Much of the efforts since independence have been focused on providing more equitable services to the society, creating more job opportunities, increasing access to education, and giving more attention to the sectors of economy from which the majority of the people earn their living. Namibia has a per capita income of $800 per annum. The main sectors of the economy in order of importance, according to 1989 figures, are: mining, which contributes about 30 per cent of the GDP; and agriculture and fishing, 20 per cent. These

statistics show concentration of economic activities in the primary industries. The country has a very small industrial base, with manufacturing companies totalling only about 260 and contributing less than 7 per cent to the GDP (Muwonge, 1991). Thus Namibia represents, in many ways, a typical DC.

2.2 IT infrastructure

While there is still a lot to be done to achieve acceptable levels of IT exploitation, it is interesting to note that proliferation of computers in the private and business sectors is surprisingly high. Banks, supermarkets, organisations, etc., use computers in one way or the other. Most of these, however, use computers mainly for wordprocessing, and a few very specialised applications like payroll. Apart from producing regular reports, computers are hardly used to improve the general efficiency and productivity, and there is still a long way to establish a computer culture within organisations. What is particularly striking is the lack of interaction on issues relating to IT between individuals as well as organisations. An Information Technology Association existed in the past to try and bring together interests of computer experts from all sectors but this failed due to what many perceived as a heavy vendor bias in the Association. A number of companies have implemented Local Area Networks (LANs). These include mining companies, banks, training institutions, etc. In contrast to LANs, there are very few Wide Area Networks (WAN) installations, these being limited mainly to banks. Very few people have E-mail facilities. However, the University of Namibia offers E-mail services to any interested party. This service was available only from the beginning of this year and interest seems to be growing rapidly (Kiangi & Hamutenya, 1994).

2.3 IT in the government

Since independence the government has shown considerable interest in the use of computers. A full Directorate in the Prime Minister's office was established and given the responsibility of coordinating computer use in the government. What the Directorate soon noted was a heavy vendor driven bias that existed in the acquisition of computer resources. As a result, it became necessary to establish an IT policy which intends to stimulate and direct IT exploitation in the government, apart from standardizing the acquisition of computer resources (PSCOIT, 1993). The greatest and most uphill task of the Directorate will be the implementation of this policy in order to ensure that the ideals expressed therein are achieved.

2.4 IT in education

At the moment there is no IT policy for education. It is usually left to the schools to decide whether or not to offer computer courses. As a result, only few privileged schools can afford to offer computer courses. Only about 6 out of a total of 1300 schools throughout the country offer computer courses. There are two institutions of higher education in the country: The Universities of Namibia and Technikon. These institutions offer a BSc or Diploma in computing. The output per year is low; typically 14 students for both institutions. Technikon offers a 1 year computer literacy course to most other Diploma students.

In short, many individuals and companies are still computer illiterate and have very little understanding of what IT can offer but there are some steps in the right direction to establish an acceptable IT infrastructure.

3. Information sources and information dissemination

In order to establish the nature of information needs in Namibia it was necessary to analyze how different sections of the community acquire and use information. The analysis focuses on four main areas of information:

1 Professional information that people use to perform their jobs;
2 Personal information that individuals may get through personal contacts;
3 Public information, usually of public interest, available through schools and media; and
4 Information systems infrastructure.

It was further established that information needs and access is not homogeneous within the society. It was therefore decided to stratify the society along vocational lines (i.e according to work). Five groups or strata were identified:

1 Information systems managers;
2 Academic and research staff;

3 Middle level staff;
4 Secretarial and clerical staff; and
5 Day labourers and unemployed.

Each section of the society above was interviewed to determine the status of the four main areas of information established above. In order to give the quickest awareness of the nature of information access and use in Namibia, the first series of interviews was conducted on the two extremes of the society with regards to information access. These were: information system managers who are custodians of information available on computers; and day labourers whose access to information is extremely limited. The result of the first series of the interviews was compiled and reported by Wresch (1994). The second series of the interviews aimed at establishing a detailed analysis of information needs of different work groups: academic and research staff, senior managers, middle level staff, secretarial staff, and the unemployed. The results of the second series of interviews have also been compiled and discussed (Kiangi, 1994b).

3.1 Professional information

The professionally senior members of the society, i.e. information systems managers, academic and research staff, and senior managers, appeared to have good educational background. Almost all had a first degree and a majority had advanced degrees as well. Most of them realised the importance of access to information in order to keep current in their lines of specialisation. Their employers are usually willing to assist them financially to keep them up to date in their fields. A few, especially the academic and research staff, felt that their employers needed to do more. They argued that they often needed to attend conferences and workshops but their requests were usually declined because of lack of funds. Many pointed out the shortage of high quality workshops nationally and in the region. Academic staff complained that it was very difficult to stay current, especially in being able to follow developments in the more advanced countries. They commented that it is not possible to get simple information like what conference is going on in what country even in their areas of specialisation. Books, journals and magazines in the specialised fields are difficult to get. Senior managers also complained that while they are able to get the necessary information due to the level of authority they enjoy, it is difficult to get relevant information since ordering a simple thing like a book requires one to know about the book first! Many of the senior staff members complained of weak or lack of professional associations that would be used to improve the skills of their members.

There was a remarkable difference in the information needs between the professionally senior members in the three groups discussed above, and the information needs of the other groups of the society, i.e. middle level staff, secretarial staff, and the unemployed. Middle level staff complained of how difficult it is to get information within the organisation in which they work. This was more so for those who are new in their work. Secretarial and clerical staff had very few complaints, and the few they had seemed more of social nature than anything else.

The day labourers stay in street corners waiting for anyone with work to pick them. Their education is minimal. Of those interviewed none was able to speak English which is the national language. They spent most of their time looking for jobs. Very few jobs that they get can occupy them for a full day, most lasting only a few hours. Many stay as long as a week without work. The greatest professional information they need is where and when to seek their next job.

3.2 Personal information

The senior professional members of the society seemed to be the ones who made best use of person to person contacts, however, information avenues showed to be highly individualistic. Most of them made contacts with people they met either in a swimming club or the like, and were able to maintain these contacts. Managers, without exception, knew of the people who could provide them with the right information. Academic and research staff relied more on people they met in schools or at international conferences. These were their main contacts who provide them with information about forthcoming conferences and other topical issues in their fields of specialisation.

Middle level staff and secretarial staff have a wide circle of friends. The friends formed the main person to person contacts. The information they get from friends, however, hardly related to information needs at work.

The unemployed and the day labourers seem to be essentially isolated from the community around them. Most of them came from villages to town in pursuit for work. Their friends and family are left in the villages, and

it is sometimes years before they are able to communicate with them. The main link wit home is through radio services where they can send greetings and specific instructions. Because of the language barrier most of them would hardly socialise. Ess ntially, the only personal contacts they have are the people they share the street corners with.

3.3 Public information

The main public information sources are the radio, television, newspapers, and libraries. The surveys indicated mixed reactions to these public sources of information. Some senior professional members said that they never watched television or read newspapers since these were propaganda items and not educative. Others said they watched television regularly, and many agreed that they listened to the radio regularly. Newspapers received the severest attack as being the poorest source of useful information. Many said newspapers and magazines from Europe and South Africa are their principle source of news. Very few said they ever used public libraries, only the academic and research staff seemed to use the libraries regularly.

The middle level and secretarial staff were regular viewers of television and radio. They seemed to read the local newspapers more than those who are professionally senior.

Most day labourers and the unemployed lacked access to public information. With their income so low, none can afford a television or a newspaper. Few of them had radios which were their main source of information. Even then, most of their time is spent seeking work and the only time they are able to listen is in the evenings. These people are only able to understand the radio services conducted in their own ethnic languages, and programs in these languages have limited coverage. Thus these same people who receive very little personal and professional information have also very limited access to public information.

3.4 Information systems and infrastructure

Large companies and organisations in Namibia have extensive and sophisticated computer systems, and quite a number have gone into networking. The very big companies usually own mainframe computers. Most information system managers from big companies expressed dissatisfaction with Telecom, the only provider of communication channels in the country. Transmission lines often go down and have very low throughput. Smaller companies have fewer computer facilities with very limited application software. Surveys conducted show an unimaginative use of software in many companies and in the public service (DSS, 1993; Kiangi & amutenya, 1994).

4. Recommendations

It is realised here that for a long time to come, resources in DCs will be severely limited and IT will have to compete with other sectors of the economy for investments. The recommendations put forward here are developed with this understanding in mind.

4.1 Selective investment

To ensure that the initial investment in IT provides the widest possible effect, it is necessary to invest in those areas with a multiplier or ripple effect. That is, investing in areas which will create excitement and interest for further investments in other areas. This means that commitment will be directed to those areas most needed and not necessarily the areas most in need of enhancement. For example, in the surveys conducted and reviewed earlier, it is clear that day labourers are the ones most in need of assistance. One may wish to develop an electronic bulletin board for them in order to be able to tell where and when hiring opportunities are vailable. However, once this facility is available, there will be little added excitement for other IT issues that will arise from the development. On the other hand, if one invests in developing IT systems for senior managers, the managers may soon appreciate the usefulness of IT. They may then recommend that IT systems be developed for the junior level staff, they may suggest more other areas of applications, and will be generally more willing to spend corporate money to develop this sector. Thus, a single investment in this case has created a need or interest of investing in another area of IT.

4.2 The E-mail and Internet services

Provision of E-mail services should be the very basic service that the IT industry should strive to offer in any DC. The discussion of the surveys above indicates that professionals in DCs are extremely isolated, with little access to

current information. E-mail services will encourage exchange of information between peer groups, making best use of the little information available. Information about local conferences, lists of experts and other local information can be made available through the E-mail facilities. One advantage of E-mail is that it requires very little investment. PTT companies (e.g. Telecom) should be encouraged to have a section that deals with provision of E-mail services.

The next stage in the development of electronic information systems should be connections to international electronic mail networks such as Internet. Internet offers access to a lot of technical information worldwide, including journals, conferences and publications. These are extremely useful to academics and researchers. E-mail and Internet services will therefore assist to meet the information needs of managers, academics and researchers. One advantage that should be understood is that within a community and peer group, a great deal of information diffuses through word of mouth and person to person contact (Vickery & Vickery, 1992). Miller (1945) surveyed how news of President Roosevelt's death was learnt among a group of students. 90 per cent of those surveyed had learnt the news within half an hour. Only a few heard the news on the radio, 85 per cent learnt by word of mouth. Greenberg (1964) did a similar study on the news of President Kennedy's assassination within a California town. 90 per cent of the people had received the news within an hour, and about half of them learnt through the word of mouth. Even among academics, person to person contact plays a significant role in the diffusion of information. Garvey and Gottfredson (1976) conducted a study on a number of scientists regarding published information relevant to their fields. It was found that 63 per cent knew of the relevant research through interpersonal communication before it was published. All these studies suggest that a few individuals connected to electronic mail services are able to provide the necessary information to the community and peer group members.

4.3 Strengthening the information resource within organisation

The analysis of the above interviews showed poor information flow within most organisations, especially for middle and low level staff. If DCs are to pull out of the 'underdevelopment syndrome', organisations must ensure that information as a resource is produced and consumed most efficiently. To take full advantage of the information resource requires an understanding of the anatomy of organisations. Anthony's model (Anthony, 1965) views an organisation as a hierarchy of decision making comprised of strategic planning at top management, management control at middle level management, and operation control for managing specific tasks. In order to include the operatives who do the actual work, a fourth hierarchy, the operations hierarchy, was later added (Davis, 1974). In all these levels, information of various kinds is needed to aid in decision making. For example, information for strategic decisions is normally clouded with uncertainty, involve a lot of money, and span over long periods of time. Information for decisions at the operations hierarchy is routine and regular.

The decision making process itself has been a subject of intensive research. Simon's model is considered as the pioneer-work in the development of human models for decision making (Simon, 1960). This model depicts human decision making as a three stage process. First is the intelligence stage that involves problem identification and data collection. Second is the design stage which involves generating alternative solutions, and lastly is the choice stage where a solution is selected and then monitored as it is implemented. Once again each stage requires different types of information. By superimposing Simon's model on Anthony's we can identify a number of different information needs within an organisation.

In the interviews, senior managers showed to be exceptionally well informed about their organisations, revealing to have good information for the intelligence stage. What they lacked are models for designing alternative solutions, handling uncertainty, and aiding in making choices. They would be well supported if they had Decision Support Systems (DSS). At the lower levels of the organisations, workers seemed to be poorly informed about organisation's activities. That is, information at the intelligence stage was lacking. Information they require would usually involve little or no uncertainty. As a result, once this information is available, the design and choice stages at this level are usually straight forward. Thus, what seems to be lacking at the low level of organisations is a reporting system which can be in some form of a Management Information System (MIS).

A different approach in modelling and organisations, called the Industrial dynamics model, was developed by Forrester (1961). Later Blumenthal (1969) synthesized the ideas of Anthony, Simon, and Forrester and formed a more comprehensive model of organisation structure and information flow. While this is considered to be a better model, it does not give us further insight to information problems of the organisations reviewed using the

information obtained in the survey.

We can, therefore, conclude that DSS systems that emphasize on models and provision of choices for senior management decision making, and an information system that provides information on day to day activities of an organisation, seem to be the most pressing information needs for organisations. This means efforts in organisations should be made in establishing such systems.

4.4 Establishment of centres of excellence

As discussed before, different surveys conducted showed and unimaginative use of software in the public service, private organisations, and even at the University itself (UNAM,1994). Middle level staff in organisations complain of limited access to company information that is useful in their daily operations. All these problems reveal the poor level at which IT is exploited. Companies also lack understanding of how computers and IT can be used to solve their various problems. Indeed in many organisations personal computers purchased at such a great cost are used simply for wordprocessing. Yet for a long time to come IT personnel who can steer companies up to an appreciable level of IT exploitation will remain a scarce resource. For the reasons stated above, it is recommended that each DC should establish a centre of excellence in IT. This centre can initially be established by the government as a parastatal and a profit making organisation. Its main function will be to advice the government and interested parties like the private organizations, on the use of computers. The centre may help companies establish DSSs for top-level management and Data Base Management & Information System (DBMIS) for sharing information within the organization. At present, virtually no organization has DSS or artificial intelligence applications while very few have DBMIS applications and even those which have do not exploit these applications to the fullest. By setting up centres of excellence to advice on IT issues it is possible that computerized information system can be developed to meet the professional information needs of middle level staff, as well as provide tools to support decision making for the top-level managerial staff.

4.5 Electronic information bureaux

In order to meet the information needs of the unemployed and the day labourers, it may be useful to establish a computerized information bureaux which the day labourers and those who are looking for work can access. Those employers needing labourers can access the bureau either through electronic mail, telephone call, or by physically reporting to the centre. The information can be entered into the computer which keeps a data base of all the day labourers, and using an agreed set of selection criteria those labourers who qualify for the specific jobs can be identified. Provided they leave their contacts, these labourers will not need to spend all day in street corners looking for work. Another advantage of this system is that the labourers will be able to specialize on a specific kind of job, even if they are casual jobs. As it is at present, the day labourers move from one job to another depending on what the day has to offer. The jobs that they are able to get have no training component so the men are unable to develop any skills on the job. By allowing them to specialize they should be able to acquire skills over time. Developing countries cannot afford to have people spending a lifetime unskilled. This centre can be run and maintained by the Ministry of Labour. The expenditure can be justified as a result of benefits accruing in terms of less time wasted by day labourers and employers seeking to hire labour, ability to specialise and hopefully acquire some skills.

4.6 Computer and IT policies

It is often argued that since finances are too limited to develop a certain sector of interest, it would be worthless to have a policy. But it is precisely because the resources are limited that it is imperative to set up a policy to ensure that the little there is be put to the best use. A sound policy outlines guidelines that seize upon opportunities and resources to provide a framework upon which specific agreed upon goals can be achieved. The purpose of a policy is to co-ordinate efforts to ensure best results. Yet a policy is not a blue print, neither is it a set of do's and don'ts that are followed slavishly. A good policy will allow an amount of discretion on the part of the implementers. It provides standards but does not limit flexibility and creativity. It stimulates action yet provide some kind of control.

Developing countries cannot afford wastage of resources, and neither can they afford to allow things to move haphazardly hoping that they move in the right direction. In order to ensure that this does not happen, there is a need to develop sound policies. Two IT policies are considered indispensable in this respect: the public service IT policy for guiding the use of computer resources in the government; and the education IT policy which will

ensure the preparation of a future workforce that will work in the era of IT.

5. Conclusion

This paper presents an empirical study designed to identify information needs of a typical developing country. A number of recommendations on how IT can be used to meet some of these needs have been suggested. It is emphasized that what the paper covered and the suggestions derived are merely the bare bones. In implementing these suggestions the bones need to be filled with the flesh; which includes the culture, politics and social setting of the society in question. Many a good projects, that are technically sound, have often failed because they ignored these important aspects. It is in no way the intention of this study to belittle these aspects. What was applied is the concept of divide and conquer: To remove a part of the big problem, study it in more detail without the interference of the other parts, and finally put the part back again to get the entire problem in perspective. This way we hope we have been able to gain a little more insight to the problems of DCs.

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Structural change via information technology in the Irish civil service: An interpretive case study

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Abstract
This case study explores the use of Information Technology (IT) by the Department of Social Welfare (DSW) in Ireland. The DSW is a civil service organisation, providing insurance based social security payments, public assistance and income support. The organisation is geographically dispersed with 150 locations around Ireland. It has experienced structural change moving from a centralised organisation. These major structural changes revolve around three priority strategies, namely, decentralisation, regionalisation and localisation, with IT playing a major role in this re-orientation. This interpretive study looks at the social interplay between personnel and the information system (IS), exploring the structural impacts of the new ISs dealing with issues such as structural centralisation/decentralisation, decision-making authority, managerial control, formalisation, task description, hierarchy and power and politics. The study involves people at all levels of the organisation, including users and IS personnel. The average experience of the participants is 15 years and, therefore, a historic and longitudinal overview of the structural changes and the reliance on computerisation is achieved.

1. Introduction

The Department of Social Welfare (DSW), is a civil service organisation, providing insurance based social security payments, public assistance and income support, affecting almost every Irish person at some point in their lives. As outlined in the IT Systems Overview, it makes approximately 850,000 transactions per week, with the total annual spending for 1992 amounting to £3.3 billion, almost 30 percent of government spending and 13 percent of GNP. This vast operation is only made possible through the use of IT and specific ISs developed both in-house and purchased off-the-shelf. The Social Welfare Services Office (SWSO), is that part of the DSW responsible for the delivery of the computerised services.

2. Research method

The purpose of this research is to examine the information systems as a whole, and identify to what extent, if any, the organisational structure acts as an impact agent on the individuals' interplay with organisational information systems, and, in turn, how the human/information systems process acts as an impact agent on organisational structure. The aim is to look at social action on the one hand and formal structure on the other, i.e. the subjective and the objective (Giddens, 1984). This study focuses on the hermeneutic (a process of interpretation and description) interpretation of how ISs are utilised throughout the organisation. According to Orlikowski and Baroudi, the primary endeavour of hermeneutics is to "*describe, interpret, analyze, and understand the social world from the participants' perspective*" (1991). This is a means of viewing information as it focuses on the interplay between ISs, individuals and the organisational structure, given their social contexts. This approach is based on Gidden's framework of analysis (1984) and other examples of hermeneutic research of ISs are found in (Boland, 1985, 1987, 1989; Walsham, 1993 and Orlikowski, 1991). Walsham and Han (1993) applied such research in their study on information systems strategy formulation and implementation in the government co-ordination agency of a third world country.

The main research techniques used were semi-structured interviews. Those interviewed represent various levels within the organisation. Specifically 15 people participated in the research, with each participant having an average experience of 15 years in the organisation. Approximately 60 percent of the participants were from upper level management.

3. The research study

An information system is of no value without the individual acting on it. ISs are viewed as part of a social process. Individuals all have their own contexts given their unique interpretations of structure, politics, culture and so on. Individuals, in turn, affect the individual and organisational context by their use of ISs. The model proposed here has a narrower focus than that of Orlikowski and Robey (1991).

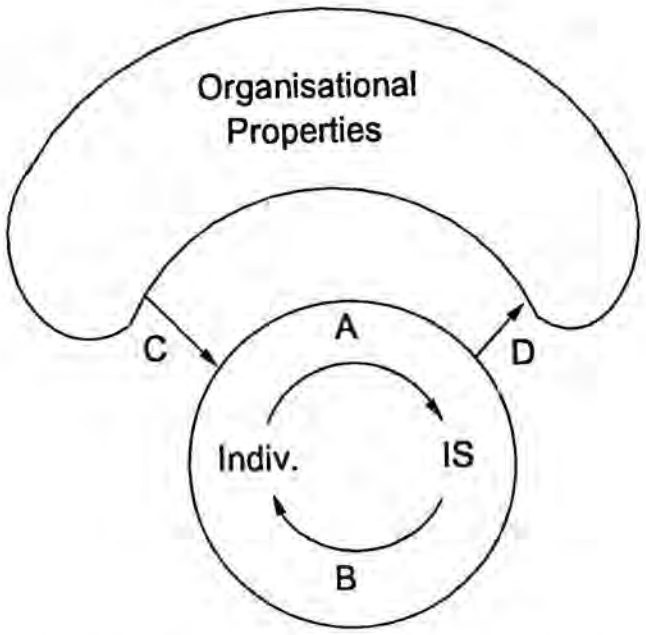

Figure 1. Interpretive model of information system in the organisational setting

The social impact agents, i.e. the information systems, the individual and the organisational contexts (properties), are depicted in figure 1. The social impact of these agents is represented by four arrows A-D. These are described as follows:

Arrow A - Consequences of interaction of IS and individuals

Information systems must be created, maintained and used by humans to have any effect on, or to facilitate, organisational action. IT is the product of human action as crafted by human action, i.e. as design, development, appropriation and modification. It is created by humans and will thus tend to reflect the assumptions, objectives and biases of system designers, given their interpretive schemes, resources and norms.

Arrow B - Information systems as a product of end users actions

Through the interpretive schemes, resources and norms embedded in the technology, the user's behaviour in using the technology will be mediated. Focusing on the structural properties of ISs alone fails to acknowledge the degree to which IT plays a role in the organisation - we have to view them as media of social action.

Arrow C - Organisational context or setting

The organisation has structures of signification, domination and legitimation, i.e. the organisation's interpretive schemes or communication patterns wherein the organisation power is centred, and how structures are put in place to control behaviour. ISs are built and used within social contexts. When people interact with systems, they use stocks of knowledge which reflect their organisation's norms and practices.

Arrow D - Organisational consequences of IS utilisation
The aim of the study is to throw up areas or aspects of linkages between organisations and ISs, taking into account the social interactions and social context. Individuals will either invoke, undermine or even transform the organisation's structures of signification, domination and legitimation, through their use of ISs. Organisational changes can occur very gradually through incremental patterns of use or non-use of the designed systems features. These modifications may themselves become institutionalised and sanctioned as proper patterns of use (Orlikowski, 1991).

The view taken of ISs is holistic, taking a complete view of individual's interaction with ISs and the organisations to ascertain the interpretations they give to ISs, and how these interpretations influence the organisation's context.

4. The case study

The specific interpretive model relative to this study is shown in figure 2, which outlines the major issues associated with the study. The following is a selection of the descriptive data collected during the study. Pseudonyms are used to protect the identity of the interviewees.

4.1 Structural changes in SWSO

Originally, there were few levels of management with a distinct gap between upper and lower echelons of the hierarchy. The communication between these levels was somewhat sparse and of a very formal nature. Given the organisation's centralised structure it was ill equipped to respond to the growing demands of an increasing live register[1]. It had recently undergone radical structural metamorphosis. This has resulted in improved communication throughout an enlarged hierarchy. The major structural changes occurring revolve around three priority strategies:

4.1.1 **Decentralisation**: Headquarters was originally located in one centralised location in Dublin. The decentralisation plan aimed at dispersing headquarters throughout the country, though not decentralising authority or responsibilities down the organisational hierarchy. Thus, as is recognised by the SWSO, decentralisation in fact means re-location. Separate functions are re-located around the country. The recent relocations are shown in Table 1 which indicates that the relocation within the Department of Social Welfare is quite typical and the scale of relocation is in line with other departments.

4.1.2 **Regionalisation**: This is a management technique, increasing the layers of management with the aim of 'putting management closer to the troops'. It was envisaged that these managers would become reinforcers of organisational goals, rather than filters of information. They are paid for specialised skills which add value to the information that comes through the hierarchy. The additional layers of management are responsible for the customer interface and the local offices. This regional structure means a relatively top heavy management within the SWSO, increasing the bureaucratic character of the organisation although the organisational goal is to increase communication and improve service quality.

4.1.3) **Localisation**: The aim of localisation is, according to one project manager: *"to bring together the totality of the organisation at local level"*. It is, in effect, an attempt to get closer to the customer, though not yet fully implemented. The SWSO will no longer be organised on a functional basis. At the most extreme, there would be no central offices with local offices acting as organisations in their own right. This has enormous implications for local offices if in fact they become a 'one-stop-shop', i.e. an autonomous unit providing a full portfolio of services.

4.2 Computerisation within the SWSO

The SWSO holds and maintains information on 2 million people. The DSW itself has been computerised since 1974 when a Transaction Processing System (TPS) was used to process General Benefit payments transfers. Up until 1985, the Department of Public Service was responsible for providing computing services.

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[1]Live Register refers to the register of unemployed people in receipt of unemployment benefits and allowances.

Table 1: Plan of recent re-locations (supplied by the Department of Environment)

Department/Office	Location	No. of staff	Provisional Completion Date
Revenue	Limerick	500	'93/'94
Central Statistics Office	Cork	450	By end '93
Education	Tullamore	150-200	1994
Agriculture	Portlaoise	150-200	'93/'94
Revenue/Environment	Wexford	150-200	1993
Social Welfare	Longford	200	'93/'94 (Definite)
Marine/ Enterprise & Employment	Kilkenny	125-150	1994
Social Welfare/ Land Registry	Waterford	150-200	1994 onwards
Office of Public Work/Revenue	Dundalk	125-150	1994
Health	Roscommon	44	1994
	Total ------->	**2094 - 2344**	

Table 2: List of systems within the Department of Social Welfare

General benefits	Central records
INFOSYS	Unemployment Payments
Child Benefit	Pensions
Family Income Supplement	Rent Allowance
Office Automation	Cheque Reconciliation
Travel and Subsistence	Management Information System
Outdoor Staff Work Returns	Qualification Certificate
Parliamentary Questions	Disability Benefit Appeals
Medical Referral	Free Schemes (Electricity, Travel etc.)
Treatment Benefits	Personalised Payment Orders
PLOW (Unemployment Payment)	Refund of Payments
Miscellaneous Payments	Self-employed

Social Welfare is classified by Pye as one of the Main Data Processing Centres, as well as Revenue, Agriculture and Central Computer Services (Now CITS) (1992). Historically, the critical applications have been those which involve payments to clients. They developed haphazardly in the sense that tasks were computerised for the various schemes as independent units with no considerations for integration between them. The role of computerisation has, however, been re-examined in a number of strategic studies from 1987 with the effect that it has now become the hub of the organisation.

4.2.1 Information systems in the SWSO

The two main systems are Infosys and ALL-IN-1 with a new system, ISTS, presently under development.

(a) Infosys

This provides an extensive client search facility whereby, using limited information such as name or address, information on the claimant can be found relating to pensions, disability benefit, central records, child benefit and

so on, by all authorised users. An extensive list of the systems within Social Welfare is shown in table 2 (Pye, 1992). In this list 'system' can denote anything from a stand-alone PC to mainframe applications. Infosys provides a uniform interface through which all systems can be accessed.

(b) ALL-IN-1

This provides managers with office automation facilities such as word processing, E-Mail, electronic filing and statistical information as well as information management, business information, time management, and some other minor functions.

(c) Information short term system (ISTS)

At present the IS division is completely structured around the development of a new system known as ISTS, an Information Short Term System. The purpose of this system is to incorporate all the short term payment schemes into one system facilitating their registration, authorization, maintenance, payment, taxation as well as recording the relevant data on the Central Records System. Thus, it is a project incorporating a number of systems which will change the way short term schemes are operationalised.

4.3 Organisational context or setting

In order that the study be carried out in line with the interpretive model developed (figure 1), the following analysis is arranged according to the headings within that model. Thus, to begin with, the organisation's structural and contextual factors determine how individuals behave, their attitudes, the way they interpret events and how the ISs evolved within this context.

4.3.1 Structural nature of DSW

Traditionally, the DSW is typified by a vertical and centralised hierarchy. There are several hierarchical levels leading to a lengthy chain of command, contracted spans of control, with a substantial number of rules and procedures dictating organisational practices. It is equivalent to Mintzberg's mechanistic organisation with a large technostructure at headquarters (1983), a strong middle management presence, narrow chains of command, and a focus on control and efficiency. Additionally, much of the decision-making tasks are limited to only the higher echelons of the hierarchy. Operational decisions, such as claim authorization, are centralised at scheme headquarters in Dublin.

Computerisation reinforced this centralisation as systems were developed in support of each individual scheme independent of one another. The rationale for the independence of computer systems was based on criteria such as shorter development time-scales and tighter controls but they lacked an integral customer orientation. There was extensive duplication with people - availing of two and three RSI numbers (a number which uniquely identifies the claimant for all interactions with the DSW).

Recent structural decisions indicate that the organisation has taken a new strategic direction, highlighted specifically by decentralisation, regionalisation and localisation plans. To date, decentralisation and regionalisation structures have been put in place, though their implementation is a continuous process. The realisation of these goals has progressed hand in hand with IS developments. Localisation in turn has been set in motion with the development of ISTS, the system which will result in the re-configuration of the already computerised systems, automating functions currently completed manually, and completely changing the way the organisation now functions.

4.3.2 Decision-making authority

Traditionally, decision-making authority has been centralised at the top of the hierarchy to maintain control over the diverse and complex operations throughout the organisation. Because of the nature of the business and involvement with the government of the day, it is impossible to involve other organisational members in the decision-making process. Computerisation within the SWSO developed supporting this centralisation with the focus on processing data faster than ever before. ISs initiated increased processing of data and its communication to headquarters where decisions could then be made.

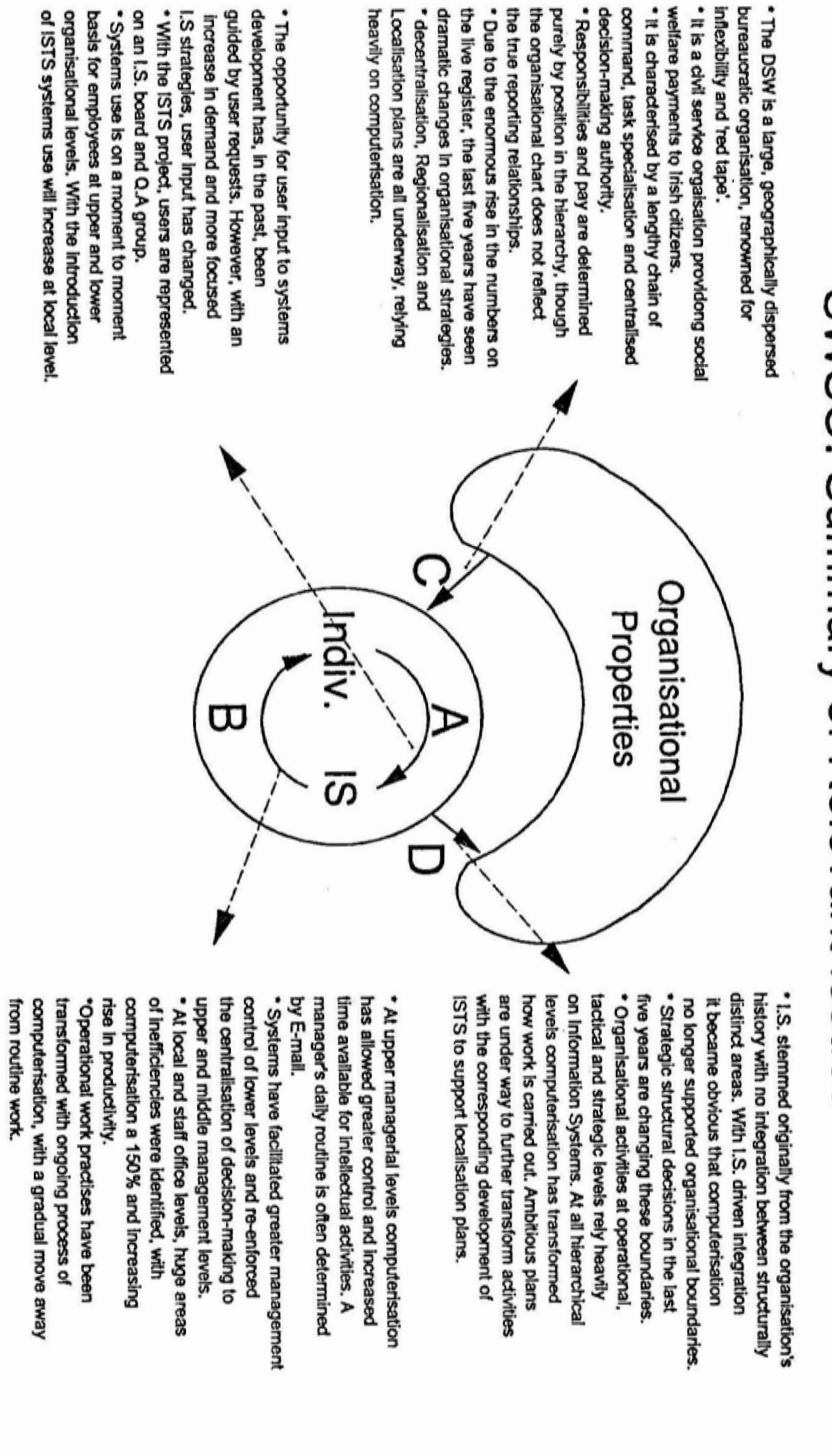

Figure 2: DSW - Summary of relevant issues

4.3.3 Managerial control

Traditionally, the SWSO could not be described as a tightly controlled operation. The huge operating core distributed nation-wide did not lend itself to close supervision. Labour costs within the SWSO were on route to rocket out of all operations if automation did not come about. To further highlight the lack of control, the ISs developed haphazardly in no guided direction. The early days were spent automating routine, and often manual, tasks such as the payment of claims.

Today, all this is changing. With the growth in the numbers on the live register, the social welfare system was becoming too complicated with 'an army of clerics', as Philip (manager of Management services) puts it, required to propel organisational efforts. Labour costs associated with maintaining this 'clerical army' became a growing concern. The SWSO 'took IT by the horns'. IS development is now driven, to a large extent, by efficiency and control. One manager points out how different audiences lead to different driving forces. The Finance department, for example, is obviously interested in cost control. They insist upon labour savings in any IS development plans.

When regionalisation did, in fact, come about excess resources were identified within the organisation. This, combined with the narrower spans of control, meant there were now more managers, each with fewer people under their supervision. Organisational goals were also now more focused and top management wanted to see results.

4.3.4 Formalization

The jobs themselves are moving away from routine work in all areas of the organisation. Though there are procedures to follow in dealing with claims, problems and requests, much of the manually intensive work has been eliminated through the use of ISs. However, jobs within local offices remain, at present, relatively standardised whereas managerial jobs have become more unpredictable.

4.3.5 Task description

Jobs are traditionally highly skilled throughout the hierarchy, though particularly routine at lower levels with an increasing tendency towards specialisation in upper managerial areas, for example, within the IS division. Within the operating core jobs are narrow in scope. The distinct specification of the role, duties and instructions for an individual's hierarchical position and the limited parameters of discretion of individual employees are all characteristics of office level positions. Work at office and investigator level is mainly routine. This leads to widespread task differentiation along the operating core, allowing easy movement of staff across the organisation. Formal management/staff relationships also characterise structure at this level. The higher up the hierarchy, the greater degree of unpredictability as complexity in a person's task environment increases. A different structure emerges here where dialogue and cross communication along similar managerial layers becomes a characteristic.

4.4 IS as a product of end users actions

We focus here on the users' role in systems development and modification as well as purposes for which they actually use the systems.

4.4.1 User input to systems development

Users have a number of opportunities to contribute to the development of Information Short Term System, the new IS project, though the actual value given to this input is questionable. There is a Quality Management Group, as part of the IS division structure, to represent user views on the development of the new ISTS. Top management realise that the user has a role to play in the development process and are trying to accommodate that. However, within the IS division people have reservations about the actual usefulness of this group. Barry, an IS manager, expresses the view that it is a mistake. In fact he has disclaimed all connections with the group refusing to have anything to do with them: *"It's a great big talking shop. A confusion of communication exists there"*. Yet he denies that there is an information gap. Instead, information is too congested and not properly structured. He claims that people don't know when to communicate, and when they do, are communicating to the wrong people: *"It's hard to know what the purpose of many conversations are"*. Yet he does not blame anyone in particular and is not essentially anti-users. In fact, according to a manager at regional level, users who are very interested in the

computer side of things tend to eventually enter the computer division.

4.4.2 Information systems development

Once the strategic decision was taken to integrate systems throughout the organisation many of the individual scheme requests were forced to take a back seat giving way to the priorities of systems and scheme integration. That is not to say that their needs were completely neglected, though one user revealed a certain amount of tension between the computer centre in Dublin and what people in the rest of the country wanted. Yet, developments which are made often benefit users greatly such as the improvements in systems integration. However, their influence as regards systems development deteriorated dramatically. They no longer had the same power to control their automated destiny. The IS division and organisational goals had taken over.

With regionalisation and the distribution of IS development resources in other locations besides Dublin, certain users have greater influence than others in having modifications made to systems. Particularly, those within regional offices where such resources are located, can suggest projects for construction locally. This is happening more and more in the quest for greater management information.

4.4.3 Systems use at the office level

Having information systems available to employees has facilitated a much more efficient operation. Employees' productivity has increased meaning a greater number of claims can now be processed by the SWSO. This was essential with the growth in the customer base. At local and headquarters offices, people use ISs on a moment to moment basis in the course of their job. It allows claims to be registered, authorised, monitored, maintained and so on. It allows users to make enquiries, gather statistics, and obtain reports where necessary. At local office level, the only functions staff have access to are those concerned with claims registration, enquiries and payment.

However, with the emphasis now on functionality, it became obvious that the payment function would be better outsourced to the banks or Post Office. EFT (Electronic Fund Transfer) and EIT (Electronic Information Transfer) are the technologies which will facilitate this move. The former facilitates the transfer of money to a client's bank account. The latter allows for the transfer of information to the banks or Post Offices in order that they may take over the payment function completely.

4.4.4 Systems use at the managerial level

In all, approximately 90 percent of reports are automated. E-mail is used to send monthly reports up, down and across the hierarchy. Queries can be made by anyone with access to the system to any one else on the system. It is, to a large extent, a formal and perhaps impersonal form of communication, though Philip (manager of management services), part of the regional management structure, feels that this has its advantages. It allows him to send out a general feeler to a large group of people and get a quick response. The system also facilitates him working anywhere in the country once logged into a terminal. This gives him a certain amount of flexibility as well as, of course, making him that much more accessible by others.

Barry, an IS manager, argues that E-mail flattens the lengthy organisational hierarchy. Though the system was brought in through the new middle managers, it now allows lower levels to communicate with upper levels, bypassing middle management: *"There is a danger of being side-lined and squeezed out, thereby functioning less efficiently"*. He feels that managers can become: *"too concerned with burrowing rather than getting their hands on productive information"*. In his opinion, the reporting structure does not rely on E-mail. E-mail use does not parallel communication paths. It facilitates multidirectional communication, without which an ambitious reporting structure would not work, making the deployment of information easier.

4.5 IS as the medium of human action

The information system impacts the individual in a number of ways, including such issues as their basic job description, their discretion and autonomy, the control exerted over them and so on. Here we will look at the impact of ISs on individuals, their decision making autonomy and IS as a control device.

The new system ISTS is devoted to providing greater management information. However, so far, management information has been synonymous with greater control over lower level operations.

4.5.1 Computerisation and the effect on individuals

Computerisation impacts not only on the employee's job at lower office levels, but also on middle and upper level managers. One middle manager jokes: *"Your life is ruined and ruled by the system. I come in with great intentions every morning to find a screen of messages which take over my day."* The first thing that this manager does every morning is log-in thereby setting his work agenda for most of the day. He admits to getting completely involved in the system as soon as he sits down at the screen. He illustrates this with an example: *"Sometimes I look at my watch and it may be 12 O'clock. The next thing, when I look it's 1.55 and I've missed lunch"*. He spends, on average, between 50 percent and 90 percent of his time using the system. Thus, the majority of his work is done through the system. *"It's infectious"*. Despite the control the ALL-IN-1 system seems to exert over his life, it allows him immediate access to all others with a log-in password which includes those from investigators level upwards in the hierarchy. The higher up the management hierarchy you go, the less routine people's jobs become. The job of this middle manager has almost no routine incorporated into it, with no manual or labour intensive work. It is a case of 'organised chaos' dictated by the computer system.

Obviously, it is people at the other end of the network who are responsible for requesting the work. However, were his job not automated he would be working at a much slower pace, on much more mundane tasks, as would all those below him in the hierarchy. He would not be able to answer the same number of requests, nor would he receive the same number of queries. He feels he would not have the same freedom to use his brain and intellectual ability due to being caught up in other people's problems. Using the IS, however, gives him the time and opportunity to work out innovative ideas for meeting organisational goals.

Managers from all levels admitted that because of a large proportion of their day being spent at the computer, they could become isolated from those around them. However, without the system there was probably greater isolation since people did not know what was going on within the rest of the organisation, hardly ever seeing their supervisors. They also had much more time to brood over decisions as everything was done at a much slower pace. So the job has become more pressurising as well. Answers are expected quickly as people have access to much of the information on or through the information systems.

4.5.2 Office level

Local offices have been transformed in many ways with the developments made in computerisation and are destined to be further effected with the forthcoming introduction of ISTS. Originally, they had been staffed for peak signing[2] of claimants. However, recent changes made possible through automation mean a reduction in the number of times a person need sign. Thus, there is no longer the need for the same number of staff. Managers also argue that higher level tasks will now be required of local office staff, especially with localisation plans soon to come to fruition.

According to Peter (Management Services) when the PPO system of payments was introduced to the local offices, it actually took away work content for 80 percent of the staff. It was difficult to get staff to accept that less people were required to do the job. Previously, when claims were dealt with it was at a certain time and they were processed as quickly as possible. Now with functionality being brought in they are not encouraged to do them any faster since that's all some people do, day in day out. They know everything about the system and can slow it down, thus not making any savings with employee numbers. So it seems that if people feel they suffer in some way from automation, they will try to find a way to rebel against it. Other managers have expressed the need for work rotation in cases where perhaps the work becomes monotonous as in the case of inputting data. Particularly, one user within a scheme area expressed regret at the fact that job rotation was not a feature of their work. Yet, a manager within the same division was quick to point out that there are those working with the SWSO who would rather not be moved and are happy with their own specialised, though perhaps routine, area. *"I suppose it is a matter of personal taste"*, she remarked.

Barry (IS manager) believes that the lower down the hierarchy you go, the less change there tends to be in relation to the nature of tasks performed. The most sudden changes, in his opinion, are at management levels. At lower levels change occurs in 'fits and starts' and is thus, overall, very gradual. Similarly, another non-technical manager is of the opinion that computerisation is not dramatically changing the tasks carried out in local offices.

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[2]When an unemployed individual receives their benefit cheque this is called "signing on"

He does not agree with the use of the words 'fundamental change' to describe what is happening to their work. Plans for the future are even more ambitious. Other non-technical managers however, such as those within Management Services, do express the view that while computerisation is a process of development over time, the effects on office staff when changes are made come as a huge shock and not in the incremental fashion as suggested above.

Office automation has meant a great deal to how tasks are carried out at all levels in the organisation. One manager explains that they had office automation long before they knew there was a term for it. Philip (Management Services) observes that: *"the days of the typing pools are gone, where if you wanted to get any work done you had to be friendly with the girl in charge"*. Other labour intensive tasks have also been eliminated such as lifting boxes of checks and tedious writing. With the introduction of ISTS, managers believe that the result will be greater knowledge at local level. However, there is also the possibility of an increase in routine jobs especially if various tasks are divided among employees within the office. Yet, even if a person is registering claims all day, unless they are all from the same scheme, the knowledge needed will increase dramatically.

Mark felt that work at local office level will also become value added in that work which is being neglected at present can be carried out, such as control checks on claimants: *"It will mean that we will see the end to low level clerical assistance as they become more professional"*. Users will also lose control over the payment of clients. Payment methods have changed dramatically over the years, moving from extremely manual systems to a situation where some are paid completely automatically. The implications here would seem to be that automation of payment means less routine work for employees, but more intensive at peak times. The aim is for a totally cashless office. However, as cash is removed from local offices, alternative functions will be devolved from head offices.

4.5.3 Decision-making autonomy

The decisions local offices make on a daily basis are routine and not of a particularly high level. They normally concern client enquiries, routine paper and computer work and so on. There are two main influences impacting on individuals' discretion as regards decision making power. Firstly, if the decision is automated it is taken out of their hands. One developer believes that many of the decisions on claimants eligibility could be automated in certain cases, where for example, it is simply a matter of counting their contributions. Trials have been run whereby the amount due to a claimant is automatically credited to their bank account. Secondly, the decision may be centralised as is the case at present with claims authorization. Local offices simply register the claim and pay out the money once authorised to do so.

4.5.4 Control

With regionalisation, changes brought about in the reporting structure meant a decrease in the numbers covered by any one manager. Thus, as spans of control decreased, the level of control increased. Part of this restructuring means that everything is now performance and target oriented. Targets are set for everyone because it is possible to find out, through the use of ISs, exactly how people are performing. Target setting begins at the top of the hierarchy, though regional managers are able to contribute to standards set for themselves.

The investigator's job has changed dramatically in that now all returns must be done immediately. Initially, some refused to use the computer. Their managers now can see exactly how much work they are doing. When the system was introduced there was a 'mad panic' among the offices as they were no where near the standards set. Since then things have improved dramatically and investigator's have started meeting standards.

4.6 Organisational consequences of IS utilisation

The purpose here is to highlight how the interaction between the individuals within the organisation and the actual systems, given the organisations contextual factors, pressurises, changes or reinforces the organisation's structure.

4.6.1 Structural centralisation or decentralisation

IT development within the DSW stemmed originally from the organisation's structural history. Systems developed in line with the organisation's structure. It was very much a 'develop on request' approach, in a time when requests were not over burdening IS staff. This however, has changed in recent years where perhaps a less centralised development process has been instigated with computerisation emanating from throughout the organisation hierarchy.

Users' views carry more weight, and other locations besides Dublin have the resources with which to develop applications. Having said that, most users would still consider IS development a much centralised operation.

The SWSO saw obvious benefits integrating data especially in order to achieve greater efficiency. So a clearer IS policy was adopted and the organisation committed itself to greater IS investment. Once integration was achieved, it became obvious that computerisation no longer supported the organisation's boundaries. The next step was then to set about restructuring the organisation, which was facilitated by the computerisation. The organisation was simultaneously reaching a stage where a new direction was needed. It chose to improve the quality and efficiency of services, using IT to facilitate it's objectives. The structural choices made were decentralisation, regionalisation and localisation; some of these policies have centralising properties, while others have decentralising properties. Each was only made possible through IS developments. As quoted in their IS Overview: *"(IT) has facilitated decentralisation of HQ Actions, the integration of local service delivery actions and the recasting of management structures to facilitate more efficient, locally focused administration of schemes"*. It is possible that these ISs played a large role in determining how these goals were achieved, especially given the power of the IS division.

The instigator of Infosys in the 1980's held the position of Director General, located at the pinnacle of the hierarchy. Thus, to a large extent, major computerisation was a top down effort. Several of those interviewed, both within and outside the IS division, agreed that the initiation and success of computerisation depended solely on the vision of this one person. However, one developer made the point that the allocation of computer resources was not according to seniority. Thus, many managers found that those working under them had terminals before they themselves had. The profusion of computers resulted in facilitating their jobs. Much of their job is concerned with receiving, editing and forwarding tasks, both up and down the organisation hierarchy. This has been made instantaneous by the system.

4.6.2 Decision-making authority

The result of regionalisation was a reinforcing of the upward referral of issues through the hierarchy, isolating operational staff to an even greater extent, and distancing them further from the strategic apex. With localisation, however, the aim is to put the knowledge and decision-making authority at the front line, making local offices more accountable. According to one scheme manager, at local office level, it will mean taking more routine work out and putting some decision-making in. Unemployment Assistance/Benefits (UA/UB) decisions have already been devolved to local offices. A branch manager predicts that he sees his staff going down to as low as 20 people where presently 100 are employed purely in maintaining the system. Yet, while the knowledge will, it seems, be pushed down the hierarchy, it is questionable whether the decision-making authority will accompany the added responsibilities. ISTS is designed to locate claims authorization either at local or headquarters level. Further computerisation may mean some authorization can be completely automated, also removing the decision from local level.

4.6.3 Managerial control

Because regional managers have business information such as statistics, processing times and so on, they know exactly what local offices are doing. There is no escaping for the area or office manager who, in the past, was in the habit of working at a pace to suit himself. Productivity could not be monitored and so there was no recognition for work well done. Philip gave examples of how he now pressurises area managers to meet his targets.

With computerisation it has been possible to have performance monitored by the touch of a button. All managers have access to this information. Thus, area managers know their supervisors have the same information on their screens as do investigators and others at local level. Knowing that you are being watched is often enough of an impetus to improve performance. However, Philip knows that setting standards is not enough to ensure they are met. The IS also facilitates him giving gentle, and not so gentle, reminders.

Most managers expressed a sense of acceptance of the extremely hierarchical nature of the organisation's structure. Regionalisation, for instance, is regarded as very much a success. It has achieved the purpose of providing a platform on which local services can be provided. With localisation, one manager remarks that it is a question of balancing out face to face communication with the client and cohesion from a centralised decision point. This belief in centralisation is stronger among management the higher up the hierarchy you move. They argue for a centralised location where the product can be seen as a whole and where parliamentary questions, relating to social welfare, i.e. numbers unemployed, can be addressed.

4.6.4 Task description

Philip remarks that ISs have freed managers from repetitive support tasks allowing them more time to spend on conceptual and decision-making tasks. Others agree that it allows managers 'more time to manage'. However, a tendency which has been growing in the upper managerial layers is the specialisation of tasks. This can be seen with the growing IS division which has emerged in support of organisational activities. Individuals are also becoming more skilled at office level with the introduction of functionality. Localisation means pushing the vast amount of knowledge required to run the complex operations down the hierarchy, encouraging initiative and greater collaboration of staff. Obviously, the need for teaming on the part of local staff is huge. Though the task they may carry out is quite routine, they still need to know almost everything about the specific scheme they are dealing with at any one time.

5. Limitations and advantages of interpretive research

The success of interpretive research (alternative to scientific research) is very much dependant on the skills of the individual researcher. Their are very few guidelines for protection against self-delusion. Thus, the skills of the individual researcher are essential to the quality of the actual findings (Boland, 1985).

Another traditional problem - that of non-replicability - is also relevant here. It is impossible that a similar configuration of events could occur again, that is, similar ISs within a similar social setting as used by individuals at a specific point in time.

However given these limitations, the research is not without its redeeming features. It identified areas of interest which could be further analyzed at a more rigorous and perhaps empirical level. Though not a particularly rigorous methodology itself, the framework allows for highlighting areas which could otherwise go unobserved, for example, the context within which the researched activity takes place. For the present research this was an essential element in the research process. The methodology has provided a rich abundance of information, recognising many different contextual relationships between information systems and organisational structure (Orlikowski & Baroudi, 1991).

The general issues suggested in the present study could be explored more explicitly over a greater time span such as regionalisation and localisation links with ISs. Given the significant impact of E-mail on the SWSO, for example, an empirical survey of the nature of E-mail could highlight precise utilisation issues. It is suggested that E-mail is an integral part of communication processes within the SWSO. However, a more empirical analysis could qualify its role within the organisation.

6. Conclusion

This interpretive study outlines how ISs act as an impact agent on public organisations and individuals. In viewing IS as a social agent we see that computerisation has many varied impacts, both positive and negative. This study also outlines the socio-political dimension of ISs. In the case of the DSW, computerisation was an enabling force in the strategic restructuring of the organisation. It has facilitated greater efficiency and dramatically increased the service provided. The adopted interpretive research methodology provides a useful descriptive framework which allows informative presentation of the ISs within the context of the organisations.

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Applications of information technology in Grameen Bank

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Abstract
This paper presents a discussion on the use of Information Technology in Grameen Bank, a pioneering development organisation. Since the Bank was set up to provide credit to the poorest of the poor in rural Bangladesh, the case places the mission and activities of Grameen Bank in the context of the rural economy of Bangladesh. The main activities of the Bank and existing IT applications are discussed. For some time, the top management of Grameen Bank has been concerned with evolving a strategy of computerisation for the bank in the next five years. Computerisation of branch offices figures prominently in the portfolio of applications being discussed as a part of the strategy. The paper discusses some of the complex issues relating to organizational culture, cost/benefit from computer use, and assessment of risks in developing an application portfolio for the bank.

1. Contours of rural poverty in Bangladesh

Bangladesh with a population of 114 million spread over 144,000 sq. kilometres is one of the most densely populated countries in the world. With a per capita income of $220, it is one of the poorest of the low income countries of the world. Its Gross Domestic Product is nearly $ 23 billion dollars of which 34 per cent is derived from agriculture. It is substantially dependant on foreign aid which accounts for nearly 10 per cent of its GDP (World Development Report, 1994).

The burden of poverty is spread unevenly among the regions of developing world, among countries within those regions and among localities within those countries. The weight of poverty falls most heavily on certain groups. Women in general are disadvantaged. In poor households they often shoulder more of the work load than men, are less educated, and have less access to remunerative activities. Children too suffer disproportionately, and the future quality of their lives is compromised by inadequate nutrition, health care, and education. In Bangladesh poverty is widespread with a reported 50 per cent of the population living below a subsistence level. It is also uneven because of the exposure of certain southern and eastern districts to natural calamities like cyclone and floods.

The extent of deprivation of the rural poor is difficult to describe. Their houses generally consist of an earthen floor, a straw roof held up by bamboo poles from which dry palm leaves are tied to serve as walls. Such a hut may be shared by five to six members of a family. Forty three per cent of the households have either no land of their own or have less than 0.5 acres of land. Majority of poor work as agricultural labour. This subsistence on agricultural labour keeps them under-employed most of the year. If they are lucky, they may get a few days of employment of wage labour in construction or similar activity in nearby towns. Their capacity to do strenuous work is low because of poor health. The women do the household work and are always on the look out for ways to earn a little extra through activities such as husking rice, weeding fields, etc. Many families must support younger children of relatives who have lost their parents to disease or disaster. Poor households spend about 85 per cent of their meagre income on food. The poorest of the poor are lucky if they get two meals a day and are able to afford more than one pair of clothing. There is a large gap between income and consumption of the rural poor. The gap must be filled by transfers, asset sales and borrowing. Widespread indebtedness to shopkeepers and money lenders has been reported. The poor have few opportunities to obtain insurance and are not able to use credit to become entrepreneurs. Those on the edge of survival cannot afford to gamble.

In recent years, large amount of aid has flown in to bolster infrastructure facilities in rural areas. Bangladesh is making a dent in its population and health problems. Alleviation of poverty still remains high on the agenda. Progress on poverty can be achieved by pursuing a strategy that has two equally important elements. The first element is to promote the productive use of the poor's most abundant asset - labour. It calls for policies that harness market incentives, social and political institutions, infrastructure, and technology to that end. The second is to provide basic social services like health care, family planning, nutrition and primary education to the poor.

2. Genesis of Grameen Bank

Grameen Bank is an internationally acclaimed success story. It all started after the independence of Bangladesh in 1972 when Dr Mohammed Yunus, then a professor of economics in US returned to teach in Chittagong University located in rural Bangladesh (Choudhury, 1990). The conditions of the poor with whom he came into contact during his visits to nearby villages moved him. He was particularly moved by the plight of a woman who earned only two pennies after a full day's hard work of making bamboo stools because the rest of the profit was taken away by a local money lender who supplied the raw material and purchased the finished product dirt cheap. Dr Yunus initiated an action research project in 1976 to rescue such poor women from the clutches of the local money lenders and to help others in self employment. Traditionally, banks have always ignored the poor by insisting on a collateral for the lending. Dr Yunus used his personal savings and a band of enthusiastic students and experimented with lending small sums of money to the poorest of the poor. A major doubt expressed by several bankers regarding the inability or the unwillingness of the poor to pay back was soon disproved. In the small communities the default was almost nil. The commercial banking sector with whom Dr Yunus pleaded to take over the project and extend the coverage to other areas was still not convinced. The commercial banks argued that the experiment in a few villages could not be multiplied on a large scale. The banks were willing to provide funds to Dr Yunus to distribute further, but were unwilling to take up the activity themselves. In the next few years, Dr. Yunus repeated the experiment successfully in more villages.

In spite of the demonstrated viability of the project, commercial banks could not be persuaded to take up the scheme to other districts to extend credit to the rural poor. It was then that Dr Yunus decided to do it alone without the involvement of commercial banking sector. A formal credit programme for the rural poor was launched in 1979 in Tangail district with the approval and financial support of Bangladesh Bank, the Central Reserve Bank of the Country. Encouraged by its initial success, it was extended to three other districts in April 1982. In recognition of the need for a separate financial institution for the rural poor and encouraged by the project's impressive success of 98 per cent loan recovery, the Bangladesh government transformed the project into a scheduled bank in September 1983.

To understand the growth and achievements of Grameen Bank, one would have to understand the philosophy of its promoter. Initially the Grameen Bank was targeted at the poorest of the poor - those who were either landless or owned less than 0.5 acres of land. Loans were extended to such rural poor to purchase assets which would enable them to increase their income. It was hoped that families which could afford only one meal a day would generate additional income to provide for a second meal.

The main thrust of the philosophy revolved around self help. This was different from other rural projects which provided outright grants and made rural poor dependant on such largesse. Not only the loans had to be repaid but they carried a fair interest rate (initially 14 per cent and currently 20 per cent). One of the unique features of the experiment was to provide the access to banking services at the door step of the rural poor. This upheld the dignity of the poor. They were provided with the credit in cash at a rural branch with a minimum of paper work. The loan recoveries were made every week through field workers in the villages of the residents. To ensure low default, loanees were required to become members of a group. Rules were so framed that the default by one member would hurt the chances of other members of the group receiving a loan. A natural group pressure was created on potential defaulters. The group also served as a support mechanism in times of need. Another significant aspect of the whole project was the objective of empowering rural women. Loans were specifically targeted to the women of the household. During initial years 50 per cent of the loanees were to be women.

Over the years with its growth and success Grameen Bank understood its power and influence over the rural loanees. It began to use its persuasive power to bring in several important social changes. Sixteen decisions were identified which every loanee was voluntarily asked to follow. These focused on some of the major social ills of Asian societies, i.e. dowry, high population, malnutrition, lack of hygiene and poor sanitation, etc.

3. Current structure, operations and growth

Grameen Bank follows a decentralized hierarchical organizational structure, with the head office at the top of the hierarchy. At the next level are eleven zonal offices. Each zonal office has several area offices under its control, and an area office in turn supervises several branch offices. On average, there are ten area offices per zone, and ten branch offices per area office. The branch office directly deals with customers. The customers are organised

into groups, each member belonging to a group whose recommended size is five. A few groups, usually eight in number, are formed into a centre. A branch supervises approximately 60 centres, and organises weekly meetings in each of its centres. It is at these meetings that several discussions take place between the bank employees and the members, and important transactions such as loan repayment. Usually loan disbursement takes place at the branch office.

Grameen Bank was formally registered as a bank in 1983. Since then it has grown enormously. From 1983 to 1993, the number of members and villages covered and the total amount of loan disbursed have all increased twenty fold. The number of branches and the staff have increased by ten fold and fourteen fold respectively. As a consequence of this growth, Grameen Bank is currently facing increasing need for decentralisation, financial viability, and human resources management. Exhibit 1 provides some indications of this growth.

The schemes for which the loans are granted by Grameen Bank are selected by the concerned member. The banks role in the choice of activity is only catalytic. The activities can be grouped into the following categories: processing and manufacturing, agriculture and forestry, livestock and fisheries, services, trading, shopkeeping, and collective enterprises. Even though the activities are chosen by the members, the bank introduces and encourages new activities from time to time. Three such new activities introduced in the recent past are housing, sanitation, and tube-well construction.

The zones differ widely in their size and loan performance. The zones with less number of branches and members are able to show a better recovery performance than those with large number of branches. Exhibit 2 indicates the scale and profitability of bank's operations in a typical year (Grameen Bank Annual Report, 1993).

4. Loan processing cycle

An aspiring member of Grameen Bank should satisfy certain eligibility criteria: the total area of land owned by a member should not exceed 0.5 acre and the total assets owned should not exceed the market value of one acre of arid land. In order to gain membership, five like minded prospective members should form into a group and the group should become a part of a centre. The number of groups in a centre ranges from six to ten. A centre is the basic operational unit of Grameen Bank. The loan proposals are discussed at centre meetings, and repayments are also collected at these meetings. As the members are expected be very poor, the paper work involved in applying for membership and for loans is intentionally kept at a minimum. At the time of registration, a group has to fill in a one page form and each member has to fill in a two page form. In this form the member has to furnish details of family income, assets such as land, livestock and poultry, and house.

A group operates a group savings account, also known as group fund, in which each member has to deposit five percent of the loan amount, and a further instalment of 3 cents at each weekly meeting. Members can withdraw from group savings in case he/she is unable to meet the weekly repayments to Grameen Bank and for special expenses such as marriages and festivals. The decisions regarding the loans from the group fund lie entirely with the group. However, the bank collects information on the way group savings are used for statistical purpose.

The amount of loan depends on the proposal under consideration. The loan is usually disbursed in a single instalment at the branch office in cash. The repayment period is generally one year, and the repayment has to be done in weekly instalments at centre meetings. A group takes collective responsibility in ensuring that the repayment is made promptly and that the loan money is spent for the purpose for which it is granted. Grameen Bank assures a larger subsequent loan only upon complete repayment of the current loan. In case a member defaults in the repayment of a loan not only she/he but the entire group foregoes the opportunity for subsequent loans from Grameen Bank. Moreover, a good credit record of a loanee makes her eligible for special loans such as for housing. The members of a centre also enjoy some social benefits such as pre-school service for children.

5. IT in Grameen Bank

Currently, computers exist only at the head office and the zonal offices. Computer activities at the head office are coordinated by the Unit Chief of the Central Computer Unit, under whom are placed ten senior officers and 16 bank/data entry assistants. The Central Computer Unit is a part of the Monitoring and Review Department.

Exhibit-1

Growth in Grameen Bank Activities

	Activities	81	82	83	84	85	86	87	88	89	90	91	92	93
1	No. of branches	24	54	68	108	226	295	396	501	641	735	915	1015	1040
2	Villages covered	433	745	1249	1988	3666	5170	7502	10552	15083	17746	25248	30619	33667
3	No. of members (000)	21.4	30.4	58.3	110.4	171.6	234.3	339.2	490.3	662.3	770.7	1100	1350	1814.9
4	Cumulative amount of credit disbursed (m Taka)*	3.7	95.6	194.9	406.4	406.7	1469.5	2279.5	3559.2	5328.2	6632.5	10000	15500	26000
5	Cumulative amount of credit recovered (m Tk)*	32.7	64.2	123.2	251.7	702.4	1168.2	1822.1	2836.4	4331.6	5424.7	NA	12265	19889

* approx. 1$=40 Takas

Exhibit 1

Exhibit-2 : Profit & Loss Account		
Year Ended 31 December, 1990		
Operating Income	1993(in Taka) (approx. 1$=40Takas)	1992(in Taka) (approx.1$=40Takas)
Interest on Loans & Advances	1055565578	522164301
Interest on Investments	165632669	176394194
Interest on Deposits	3701750	2010045
Other Income	100331280	71825311
Total Income	1325231277	7723393851
Operating Expenses		
Interest on Deposits	15846216	101894779
Interest on Borrowings	235488157	89032709
Salaries and Other Related Costs	579780022	389189147
Directors Remuneration	7400	2200
Other Expenses	330318005	178025402
Depreciation	18225791	19904181
Total Expenses	1315665591	778048418
Net Profit	9565686	5654567
Appropriations:		
General Reserve	25000000	12000000
Reserve for Unforeseen Losses	2566000	700000
Employees' Welfare Fund	1427662	688270
Total	28993662	13388270
Balance carried to Balance Sheet		

Exhibit 2

At each zonal office there is a zonal computer unit headed by a senior officer who supervises the bank assistants and data entry assistants of the Unit. The Zonal Computer Unit as a whole is under the Unit Chief of Monitoring. The central computer unit at the head office has 15 stand alone PC systems and a super micro system. Each of the zonal offices is equipped with either a PC AT or XT.

5.1 Major applications

Most of the computer processing of Grameen Bank takes place at the head office. Data flows from branches to the head office through the area and zonal offices. For some applications, the zonal offices consolidate the data in their zones and send it to the head office on magnetic media. Existing computer applications can be grouped into:

1 Generation of statements on regular banking operations;
2 Periodic summary of zone-wise, area-wise performance;
3 Profit/loss statements and annual report preparation;
4 Personnel management(under development);
5 Inventory analysis;
6 Desk top publishing in Bangla and English languages;
7 Payroll for head office staff; and
8 Financial planning.

5.2 Performance monitoring

Among these, performance reporting system and the financial planning model are the key applications from the view point of top management. Some of the main reports generated by this system are:

1 Consolidated zonewise performance report, showing cumulative figures and monthly figures;
2 Zonewise comparative statement on disbursements, number of members and number of branches;
3 Zonewise loanee analysis showing number of loans pending for more than 52 weeks, number of members awaiting loans;
4 Zonewise statement of savings and share purchases;
5 Cumulative statement on loanee analysis, showing number of waiting loanees, first time loanees, second time loanees etc, for each zone;
6 Zonewise statement on number of schools operating and other programmes such as number of dowryless marriages, number of packets of seeds and plants distributed, etc.;
7 Zonewise statement on collective loans;
8 Statement on problem loanees, drop outs from groups, deceased members;
9 Areawise statement of loanees exceeding the 52 week limit of loan repayment;
10 Zonewise six monthly percentage trend report of unrepaid loans;
11 Statement of top ten branches on loans not repaid, exceeding 52 weeks;
12 Statement on joint loans over due in top ten branches;
13 Statement on overdue loans exceeding a certain amount; and
14 Statement of top ten areas, and top ten branches.

This system is used by the top management as the main mechanism to help them monitor the performance of branches and take corrective actions if necessary. Such monitoring is necessary and important as Grameen Bank has witnessed enormous growth in the past and is currently operating on a decentralised basis. For the zones, areas, and branches the system performs a useful function in providing feedback on their relative performance. Without computerization, the variety of statements, and the timeliness of feedback would not have been possible.

Grameen Bank has also developed a computer application using a spreadsheet to make a number of financial projections. An important conclusion from this model is that a typical branch would start making profits from the eighth year after its inception. Currently there are 557 loss making branches of Grameen Bank. None of these branches have completed the above breakeven point of eight years. According to the model, by the end of 1993, approximately one third of all the branches will earn some profit.

5.3 Top management concerns regarding IT

Some of the questions raised by the top management regarding the future role of IT in Grameen Bank are reproduced below:

1 Initially, the bank began using computers with the limited objective of performance monitoring of the various branches. This application is now very successful, and it gives a good picture of the profitability information about the various branches. Should the use of IT expand considerably?

2 Currently, computers are provided at only the head office and zonal offices. With increasing decentralisation and with increasing geographical spread of the bank, the bank should now think of providing computers at lower levels also. There should be an appropriate strategy of introducing computers at lower levels. Should Grameen Bank first computerize the branches or area offices? Should Grameen Bank be content with PCs or is there a need for introducing mainframes?

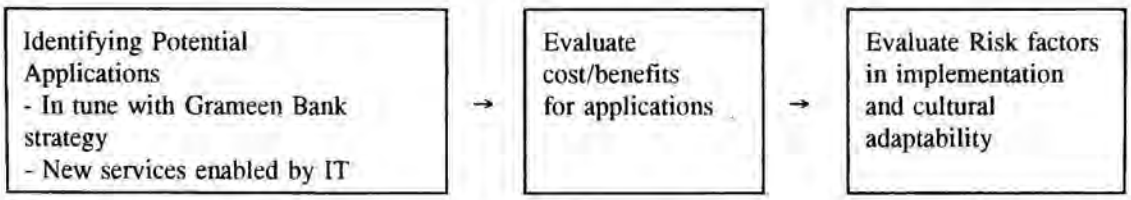
3 Currently not much information is available on the financial history of a loanee. Such information will be necessary to make a good assessment of the impact that the bank loans make on the financial health of its clients. There is also a need to computerise the shareholder data.

4 There is a gold mine of data being kept currently in the manual records. By analyzing this data, several insights could be gained about the bank's performance as well as the socio-economic conditions of Bangladesh. Several other agencies could also benefit from this data. The basic application form for membership is an example of a document which is worth computerising. Does this form need any modifications? How can this data be made available to others?

6. Evolving a framework to plan future role of IT in Grameen Bank

As per the prevailing norms of yearly spending on IT in the banking industry in the West, Grameen Bank should be spending close to 1-2 million dollars annually. The fact is that Grameen Bank spends hardly 0.1 per cent of its annual turnover of approximately 13 million dollars on IT currently. They have a total of 50 PC class machines in use. The top management of Grameen Bank was very keen to promote greater use of IT. They were seeking assistance from consultants in developing an IT strategy. Some preliminary thinking had led the top management to veer around to a view that Grameen Bank should promote the use of IT in its branches.

In the following sections different perspectives that can be used for developing an IT strategy for Grameen Bank are discussed. The age old dichotomy between the perspectives of systems rationalism and segmented institutionalism (Kling, 1980) continues to be valid even today. A rationalist approach would look at key management tasks within Grameen Bank and identify an application portfolio which will make the performance of these tasks more efficient and effective. On the other hand, a segmented institutionalism perspective approach would look at the disfunctionalities of promoting extensive use of IT within the Bank. We propose a synthesis of these two approaches as a step by step process in which potential IT applications are identified. Using a rationalist approach and a segmented institutionalist perspective, in assessing the risk factors in implementation, the impact of these applications on the organisational culture is evaluated. A framework depicted below of identifying potential benefits, evaluating cost/benefits and evaluation of risk factors can help Grameen Bank generate an application portfolio for the future.



It is the combined assessment of hard and soft evaluations which will allow Grameen Bank to decide the application portfolio that should be taken up.

An understanding of key managerial concerns can help generate various options for future use of information technology at the Bank. This is presented below.

7. Key management issues

Grameen Bank has seen an impressive growth in its activities during the last decade. Its coverage now extends to more than 33,000 villages. The number of branches have grown eight fold from around 150 in 1984 to nearly 1,040 in 1993. From the types of activities that Grameen Bank has been involved in, the following missions can be inferred (Shams, 1992).

To extend the coverage of the rural credit programme for the poorest to increasing number of villages in Bangladesh. Most of the growth in the past seems to have come through such an extension of coverage. It is unclear whether the bank is interested in bringing into its hold more of the poor from the villages in which it is already operating. A comparison of the number of targeted households meeting Grameen Bank criteria and the number of actual loanee suggests that there exists a large potential for growth even within the villages already covered. This would mean greater effort in extension and education to convince the laggards that they could benefit from the loan schemes. Perhaps the existing clients represent the early adopters amongst the rural poor.

The mix of activities of Grameen Bank has also been evolving. New schemes for loans have been introduced and different types of loans (for example term loans for housing) are now being given. The effort clearly is to create an impact on the socio-economic conditions of the poor. However, socio-economic development is a multi pronged activity. Credit is but one of the inputs required for such development. Creation of infrastructure like roads can provide access to wider markets and better inputs; provision of services for marketing and improved design can bring in more revenue; advisory help in terms of bringing in new tools and technology can increase productivity. All such complementary services can help in getting greater mileage out of the loans being provided to the rural poor. Should Grameen bank play a role of coordinating agency to bring such services? Today it is sufficient if the scheme is viable, i.e., loan is repaid. However, there is no guarantee that the loan is used for a scheme which can produce the maximum additional income amongst several productive activities that could be possible. Does Grameen Bank take over the role of the government in creating socio-economic change? Should it remain just a credit agency focusing on minimising default of loans? Should it play an advisory role in preparing development plans for villages and regions because it has a wealth of information about the people in these regions? Clarity on some of these missions will enable the bank to develop appropriate management practices of which the use of IT is just one component.

In terms of mobilising rural savings Grameen Bank has taken up the activity as a secondary mission. Should it take up this activity with the same keenness as extending rural credit? This could eventually facilitate the expansion of rural credit.

Even if the bank's missions were restricted to be a credit agency and all other benefits to the poor were considered as by-products, the phenomenal growth of the bank still requires that the management focus on a few key areas. These areas are discussed below.

Grameen Bank's success has depended largely on the zeal and motivation of its field staff. In the early years success and the consequent local and international recognition have perhaps stimulated the staff further. However, as success becomes routine in areas in which the bank has operated for several years, new challenges will be required to keep the staff motivated. Thus the bank may have to constantly innovate, in terms of schemes and ideas, and pursue goals other than just extending credit for proven schemes.

The age profile of bank employees would also change over the years bringing middle age, seniority and postings to area and zonal offices which would mean a distance from the field activities. The immediate rewards of seeing poor families turn the corner would be lost. There would be more routine work. If such personnel placed largely in branches/area/zonal offices were to concentrate on routine transactions and monitoring activities their motivations would suffer. Innovation in administrative practices and more involvement in planning (which is a creative process) can keep up the involvement of such staff and the missionary zeal.

At the corporate office, with increasing distance from field realities, there is a definite danger of bureaucratization. In addition to the monitoring task officers at corporate office need to get involved in developing strategic plans and scenarios for the future. There is a wealth of temporal data with the bank on thousands of clients. Research projects to analyze such data to develop a better understanding of the impact of the bank could help corporate level managers in contributing creatively to the process of strategic planning.

Just like any other organization the growth of Grameen Bank would necessitate a tighter monitoring and control system. In conducting cash transactions with thousands of rural poor in remote villages there are always

chances of leakage of funds. How does the bank ensure that it is insulated from the corruption which is so widely prevalent in almost every aspect of private and government activities in the region?

The bank prides itself on its economic viability. In 1992 it showed a loss for the first time. How does the bank maintain the overall viability and yet venture into more difficult areas and riskier schemes? The process of planning which is based on the analysis of existing operations could be of great help. It is possible for the bank to understand the characteristics of profitable versus unprofitable branches, and viable versus unviable schemes. The bank has to continuously control its administrative costs so that its total expenditure is within the spread provided by its borrowing and lending rate. With greater expansion, the costs involved in reaching distant areas may grow disproportionately. Mechanism for developing norms of staffing and budgeting for administrative costs may be necessary. Since the bank has also mobilised deposits, appropriate investments of surplus funds to maximise return within an acceptance level of risk may be another area which would need management attention.

It is interesting that a traditional approach to developing an IT application portfolio for Grameen Bank would have immediately thrown up a possibility of computerising the operations of zones and branches. Given the large volumes of transactions, processing of loans at branch level emerges as one of the potential areas of IT application. Grameen Bank processes nearly two million loans a year. Since the repayment is a small weekly payment, each loan of about $70 generates several repayment transactions. There is an army of about 8,000 clerical staff who process these loans in nearly 1,000 branches. An IT based system for processing loans at branch level could allow Grameen Bank to add more loanees without increasing the staff strength in the existing branches. It could, therefore, reduce the employee cost for transactions. In fact, several groups of managers who have analyzed a case study on Grameen Bank have proposed computerisation of branches. The proponents of branch level computerisation have argued that:

1 Branch computerisation would enable Grameen Bank to capture massive amounts of data on rural clients which can be analyzed for a variety of purposes. It will reduce the work of generating performance reports at the zone and regional level because these reports could be produced automatically;
2 Computerisation at zonal and regional levels will release some time for the supervisors which can be devoted to field-work;
3 Some of the MIS reports can be more detailed and based on sharp indicators which can be computed early in a computerized system; and
4 Generation of accounting statements will be faster and more accurate.

8. Identifying the application portfolio

Given the managerial issues outlined above, the next phase of computerisation can focus on the following:

1 Reduction of costs through automation of zones and branches;
2 Building a system for micro level planning and monitoring for use at the branches; and
3 Building decision support systems for use at corporate levels, assess the impact of Grameen Bank on rural poverty and for supporting strategic decisions of expansion of activities.

In the subsequent sections, we will focus on applications of 1 and 2 because the top management of Grameen Bank is extremely keen to implement these. In fact, some work in developing software from branch banking has already begun. The following sections illustrate how the three stage framework discussed above can be useful in deciding whether Grameen Bank should invest in computerised branch banking.

8.1 Cost-benefit analysis of branch computerisation

As against the above advantages, a cost/benefit analysis and risk analysis indicates the following negative implications:

A detailed analysis of the activity levels at each branch will allow an analyst to determine the economic viability of such computerisation. The table below presents some data on the number of transactions per branch, operating profits of branch, cost of computerisation at a branch, and value of average transaction.

Table 1: Number of transactions per branch

Data on Loan Transactions	
Number of villages handled at a branch	25 - 30
Members per branch	1,000
Amount of loan per loanee	$70
Amount of savings deposited at different times	$0.03
Amount of repayment per week	$2-3
Number of staff handling transactions in a branch	7
Annual cost of staff per branch	$5,000
Operating profits per branch	$100

It is apparent that the cost of computerising a branch would be nearly $1,000 per annum. This is computed on the basis by the investment (spread over a life of 4 years of maintenance cost, stationery, electricity and other operating costs) and cost of training existing employees. This represents nearly five times the operating profits per branch. This means that if Grameen Bank has to maintain its operating profits, it must show a saving in some area. This saving can be made in the cost of employees per branch which works out to $5,000 per year. Perhaps two employees would have to be reduced at every branch for the investment in IT to pay for itself. Implications of such a reduction in employee are discussed later.

As compared to industrialised countries, one of the problems of processing transactions in developing countries is the low average value of the transaction. As in the case of Grameen Bank, each loan is $70; each repayment is $2-3 per week and each contribution to saving is two parts - 3 cents plus $3. Naturally, the cost of processing a transaction is a little more than in industrialised countries because of the higher costs of computer hardware and software. In spite of this asymmetry in equation, initial applications in most organisations tend to focus on processing transactions.

Given the large variety in every condition, physical terrains, health status, social structures of the rural poor, etc., visits by supervisors to field offices provides a wealth of data beyond the facts and figures on operations and performance. Building computer based MIS poses a real danger that the system may become a substitute for field visits. On the other hand, armed with special reports a field visit can be more productive.

8.2 Risk analysis for branch computerisation

Perhaps the strongest argument against branch computerisation is the impact it may have on the organisation culture. Will the introduction of computers with field staff/front office intimidate the rural client? Will it introduce more formal procedures which will impede communication? Will computerisation mean unnecessary energy spent on the field staff on mastering a new technology and overcoming all the attendant fears that it may bring; will new technology create fears of 'unemployment' and hurt motivation or will it excite the field staff as it will offer opportunities for learning a new field?

Grameen Bank has consciously designed its systems and structures so that its clients find it easy to interact with functionaries of the Bank at various levels. Even the Corporate Office of the Bank in Dhaka is simple. It has no lifts. There are no air-conditioned rooms for senior functionaries. The interiors are so designed that they do not intimidate the rural visitors.

How dependent will the field staff be on computers? Given the difficulty of maintenance of machines in rural areas, would higher dependence on machines for operational tasks pose problems? The electricity supply

situation and the state of buildings in rural areas would mean that some branches will not be able to operate a computer. This would mean that a dual system will need to exist with some branches having been computerised and others still operating on a manual system.

In the networked world of today, branch computerisation without linking every branch to higher levels may seem like a step backward. However, to manage a wide area network application in a country with poor telecommunication infrastructure will be difficult for the best experts. Given the current expertise of Grameen Bank in IT, it will be a very difficult task.

Given the fact that repayments are collected by the staff in village meetings and these account for 80-90 per cent of the transactions, the only way the operations can be completely computerised are by providing notebook computers to field staff. Besides the enormous costs as against marginal benefits, the risk of unsuccessful implementation seems to be large.

In application of the above framework it is the risk evaluation which is most difficult, particularly so in developing countries where there is little experience of large investments in IT. Much of the risk assessment is based on the impact on behaviour of individual employees when new technologies are introduced. Unfortunately, there is not much research focused on the impact on individuals in the cultural context of Asian developing countries.

9. Conclusion

In conclusion, perhaps the next stage in the use of IT at Grameen Bank should focus on zonal offices and 103 areas to capture loanee history from manually recorded transactions. This will enhance the quality of performance monitoring, serve the needs of a data base for planning development programmes and preserve the quality of contact with the client.

The IT applications developed so far have focused on supporting corporate administrative functions. A major application has been built to monitor performance of various branches, zones and regions. Clearly IT has so far been used in back office operations hidden from the clients. Some of the managerial concerns expressed earlier would lead one to believe that the future IT application must also focus on management support at the corporate level. This support could be in the nature of building a decision support system for evaluating a variety of strategic options of projecting alternative future scenarios of growth and opportunities. In fact, some of the application ideas being toyed with go well beyond Grameen Bank in their potential utility. It is being argued that massive data gathered in manual form on rural clients can be analyzed to formulate development plans for rural areas which will obviously be implemented by the Government with the support of several agencies. Grameen Bank would thus become an agency in formulating the plans and not an implementer per se. In a sense IT would then enable Grameen Bank to perform a new role outside its original charter.

It is possible that an external IT consultant may oversell the use of IT on the basis of experience elsewhere and commit Grameen Bank to a project which has an appreciable risk of failure. Given a track record of success, it is likely that such a risk will be underestimated in an internal assessment.

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Transferability of information technology and organisational practices

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Abstract
In this paper we argue that organisations in developing countries should be cautious when they adopt systems development methods and try to introduce organisational change by means of implementing information technology (IT) based information systems (IS). Transfer of techniques, methods, models and organisational practices, may impede rather than facilitate the utilisation of the potential of IT in developing countries. Organisations in developing countries need to learn ways that can serve their own requirements. To that end, developing countries may gain much more by following the theoretical efforts that have been made in the West to understand the nature of IS and organisational change, rather than by transferring practices packaged in the form of methods or organisational change recipes.

1. Introduction

Information technologies have been developed in industrialised countries, to satisfy the socio-economic requirements of their context. Nevertheless, the developmental potential of IT is well recognised, and most developing countries are keen to exploit the potential benefits of productivity, organisational effectiveness and business competitiveness that new IT is associated with. Concern about the low diffusion of IT in many regions of the world, such as in Africa and parts of Asia and Latin America, leads many authors to emphasise the significance of establishing effective ways of technology transfer from industrialised countries. In order to accelerate the utilisation of IT in an effective way, to avoid waste of scarce hardware and software resources, and increase the chances for successful projects, it is often suggested that developing countries should not only acquire machinery and technical know-how from industrialised countries but that they should also try to transfer sound systems' development methods and organisational practices.

In this paper we examine critically such suggestions and argue that current emphasis of IT transfer may retard rather than promote IT use in developing countries. We identify two main risks. First, trying to transfer techniques, methods, models and organisational practices may impede rather than facilitate the utilisation of the potential of IT in developing countries. Each systems development method implies a particular rationality for organising and carrying out complex tasks which may be incompatible with the rationality that prevails or is effective in an organisation of a developing country; business activities models and methods that proved useful in the West may not be effective in a different organisational environment. Second, we argue that by making efforts to learn the ways IT is used in industrialised countries, organisations in developing countries fail to discover ways that can serve their own requirements. We demonstrate such risks by presenting briefly a case of a company in South America which tried to follow the logic and the practice of IS planning as theory suggests with poor results.

The question, therefore, we consider valid to address is what aspects of IT and what part of the knowledge concerning its use that has been accumulated in industrialised countries are transferable? We suggest that while hardware, generic packaged software and the technical knowledge to operate them have to a large extent to be imported, caution should be exercised about transferring practices that have proved valid in a different context. Particular methods, and methodologies should also be adopted only if it is understood that they can be useful within an organisational culture. To that end, developing countries may find the ongoing debate about the nature of information systems and the systems development process particularly relevant.

In other words, we argue for the de-coupling of the technical components of IT from the problem 'solutions' they support, and the dominant rationality of addressing information issues that the most widely recommended methodologies tend to convey.

2. The nature of IT transfer

There is a vast literature on technology transfer, partly concerning the business of multinational corporations, and partly the socio-economic development of third world countries and, more recently Eastern European countries. Literature surveys such as those by Farok and Sagafi-nejad (1981) and Sagafi-nejad (1991) suggest the existence of an abundance of empirical data and theoretical perspectives from many different disciplines. However, relatively little effort within this domain has been made to understand the process of IT transfer and its impact, despite wide recognition that IT is the most significant technology of the 1980's and 1990's (see for example (OECD, 1988) and (Freeman & Perez, 1988)). Characteristically, a greater number of publications in the technology transfer literature concern the production of micro-electronics than the development of information systems for business purposes.

Perhaps the most systematic effort to examine the efforts of organisations in developing countries to transfer IT into their information systems is the research by Odedra in Africa, in the mid 1980's (Odedra, 1990). She identified five main channels of IT transfer: acquisition of IT, education and training, technical assistance, licensing, and direct foreign investment. Her studies suggest that despite efforts made, the results of the transfer are disappointing. Many projects fail, and a number of those which succeed to deliver a technical system do not have a significant positive impact on the performance of the organisation, while their equipment is often under-utilised.

The IS literature tends to support Odedra's findings. Many ambitious projects - in terms of technology and objectives - are announced and sometimes described in detail (see for example Salih, 1981; Han & Render, 1989), but implementation and post-implementation studies are rather rare, and reveal difficulties and discrepancies of the results achieved from the expected improvements of the organisation's performance (Madon, 1994). Typical problems quoted in such studies are inadequate supporting environment in terms of maintenance and operation skills, and aspects of organisational culture which do not permit the utilisation of the technology based system in its initial specified way. Thus, recommendations often include the development of managerial skills and organisational capacity to support the IT transfer process.

In order to understand the nature and the significance of such problems it is useful to acknowledge that, in the case of IS applications (i.e. excluding the construction of automatic devices and scientific applications) IT transfer comprises the acquisition of hardware, software and telecommunications, the development of technical skills and an infrastructure for technical services, and the development of an organisational capacity to manage projects for the application of IT in the tasks of the organisation. Successful IT transfer is accompanied by the transfer of organisational structures, routines and skills. This last element of the IT transfer process in the case of IS applications, organisational change, seems to be most problematic and has received relatively little attention.

The general technology transfer literature identifies efforts to transfer organisational structures and processes as the transfer of a distinct type of technology, referred to as organisational or 'soft' technology (Morgan, 1991; Westney, 1991). It is acknowledged that the transfer of such technologies is assuming growing significance, but the process of the transfer is not well understood and remains particularly problematic. It is understood that the transferred organisational technologies tend to be adapted to the local context, rather than being used in the same form as in the context where they were first developed. However, little research has been done to understand the factors which shape such adaptation and the organisational and social change that takes place. The transfer of organisational, often firm-specific technologies, which are of paramount importance to the service industries, was identified as a major area of further research in the field of technology transfer (Sagafi-nejad, 1991).

Westney (1991) makes a distinction of technology transfer according to the extent they involve the transfer of organisational technology:

1 purely physical technologies;
2 physical technologies that are supported by certain organisational technologies;
3 organisational technologies that are supported by certain physical technologies;
4 purely organisational technologies.

Information systems projects belong either to the second or the third of these categories. We can distinguish between:

1 projects which aim primarily at introducing new organisational structures or processes, and they involve the development of IS systems as part of the effort to achieve this, and
2 projects which aim at introducing IT in order to improve the information systems of the organisation, and by doing so they result in organisational changes.

For example, various programmes for institution-building in developing countries that are sponsored by international development agencies can be seen as efforts to transfer organisational technologies, and they usually involve IS projects such as the development of databases to provide required information infrastructure. Similarly, the adoption of management practices, such as total quality management, or business planning by companies in developing countries is usually accompanied by the development of decision support systems to facilitate managers in the new roles required for the new organisational functions. In other cases, the transfer of organisational structures and practices that have proved to be effective in the context of industrialised countries is a requirement for the successful implementation or an implicit objective of IT projects.

In cases which involve the development or acquisition of IT in order to support the transferring of some desirable organisational structures or processes, there are expressed organisational change objectives which are systematically pursued. In addition to the prime organisational transfer aims of such projects, the implementation of the IT component implies further organisational requirements. First, the organisation needs to develop the capacity to manage the systems development process and the sustained use of the resulting IS resources. Second, the technologies implemented, as well as the adopted process for their development and use, often introduce their own dynamics for changes in the structure and practices of the organisation.

Information systems projects which do not have explicit goals of organisational change still convey pressures for organisational adjustment for the management of the systems development process and the resulting IS resources. In addition they may be catalysts for other organisational change, such as centralisation or decentralisation of decision making, or re-distribution of responsibilities to employees.

The significance of research in understanding organisational issues in different cultures and politico-economic contexts cannot be overemphasised. Little is known about the relevance of even fundamental concepts of western organisational theory, such as 'administrative rationality', or 'entrepreneurship' in other social contexts. To assume that they are universally applicable or necessary to be transferred in all organisations bears the risk of missing out local characteristics, perhaps equally or more valuable.

Nevertheless, there are two points which we can elaborate upon in this paper. The first is the transferability of methods of the systems development process. The second is whether IT is linked with organisational imperatives of structure and process.

3. The transfer of IS development methods

During the nineteen seventies and nineteen eighties, the application of IT in organisational activities was studied extensively in the USA and Europe. The information systems development process was modelled as a life cycle and systematised in sets of methods, the most prevalent type of which is the family of 'structured methods'. In addition, various techniques and computerised tools were developed to support the effective application of methods. Such was the significance attributed to the systematisation of the IS development process that the debate on the relevant merits and disadvantages of proposed methods - the 'methodologies' issues - dominated the research agenda of information systems for almost two decades (Avison & Fitzerald, 1988; Olle et al., 1991; Avgerou & Cornford, 1993).

Initially, systems development methods were concerned with the more technical parts of the systems development process, programming, design, and detailed analysis of data and functions to be handled by the technical system. Gradually, though, emphasis on methods shifted towards those tasks of the systems development process which involve organisational interventions, such as deciding on IS requirement in business rather than technical terms, implementation of a new IS, management of the use and evolution of information systems to secure their effective and long life. More recently, research and training efforts concentrated on methods for aligning decisions for developing information systems with business plans, and methods for the management of IS resources (Earl, 1989). In parallel with research and training for the diffusion of systematic IS development practices, there have been two other streams of effort worth-while mentioning at this point. The first is project management, dealing mainly with questions of efficient allocation of financial, staff, and time resources according to the needs of the IS development process (Berkeley et al., 1990). The second is evaluation, dealing with forecasting or assessing the benefits in relation to the risks an organisation faces with the development of a new IS (Symons, 1991; Farbey et al., 1993).

In the nineteen nineties, the debate on methods continues in much lower tones. Undoubtedly, a number of practices for systems development have become common among IS professionals, such as structured programming,

or systems analysis techniques. Methodology based systems development practices have been adopted by a number of organisations, mainly public sector institutions, corporations, and large IS consultancy and software firms. IS planning, management and evaluation methods are applied much more eclectically.

All in all, the methods movement has spread some good practice and has produced some complex products which proved their validity in several demanding projects of particular organisational contexts, but its strength has been diminished with time. Several trends have contributed to this, including the increasing significance of more flexible technologies, such as microcomputers and networks, a shift from well defined and structured application areas, such as accounting transactions processing, towards more idiosyncratic information handling tasks - such as office work -, disillusionment with efforts to 'rationalise' processes which are more political than engineering in their nature.

Efforts to spread systems development methods have reached developing countries as well. Expatriate IS consultants and local IS practitioners trained in industrialised countries apply their preferred methods and often try to standardise its use by in-house training, although there is not much evidence about widespread diffusion of systematic methodical practice.

Many feel that slow diffusion of IS methods is one of the factors responsible for poor IT utilisation in developing countries and recommend educational efforts and policies to that effect, while others argue about the significance of choosing the right methodology for particular project circumstances. Bell, for example, proposed the use of self-analysis and pre-analysis techniques to make explicit choice of systems analysis and design methods by considering the intellectual background of the analyst, methodological preferences, and the problem context (1992).

Others are sceptical about the appropriateness of methods that have been developed for western organisations. There are concerns that formal procedures, such as making an IS strategy cannot be sustained in the culture of many organisations in developing countries, and that our understanding of cultural transformation dynamics is too limited to be able to make effective methodological recommendations (Madon, 1994).

Such concerns are not unknown in the field of IS in the industrialised countries. Perhaps, in the longer run, the main value of the methodologies debate is as a platform from which a better understanding about the nature of information systems and of the IS development process has emerged. There have been cautionary voices that excellence of organisational performance, and in particular successful systems development, is not a matter of methodical practice. It has been argued that effective management and systems development require creativity and are largely driven, often informally, by the interests of an organisation's participants (Ciborra, 1991).

Moreover, systems development methods have been seen as adding to systems failures, rather than securing the development of successful systems. The reason for this is that the prevailing methods are too limited in scope, unable to cope with the social nature of the systems development process, and therefore jeopardising efforts of improving organisational performance by introducing IT.

A number of alternative perspectives of the systems development effort have been proposed (Lyytinen, 1987). Although they have not resulted in new widespread methodical practices, they have, nevertheless, influenced the way IS researchers and practitioners approach their tasks. For example, even though participation is rarely practised in the systematic way that the proponents of the socio-technical perspective suggested (Mumford & Weir, 1979; Land & Hirschheim, 1983; Land et al., 1980), most systems practitioners came to understand that ignoring the views and concerns of the participants of an organisation regarding the information system under change, may have detrimental effects on the success of their project.

In summary, the systems development process involves much more than the methodical execution of some technical tasks; it is an 'organisational technology' in Westney's terms (1991). Successful systems development is more a matter of judgement of what organisational changes are feasible and desirable and how they can be realised, than the adoption of some formal arrangements and the acquisition of formal skills. However, such judgement can benefit from knowledge of the theoretical efforts that have been made to understand the factors that affect the process of organisational change.

4. IT transfer and organisational change

The impact of computers on the structure and processes of organisations has been the subject of a great deal of research. For example, in the days of the mainframe computers there was significant evidence that computerisation

had a centralisation effect (Laudon, 1974). Even in cultures which valued decentralisation of power to local communities, such as Norway, the advent of first generation computers in their public administration had centralisation effects (Wiese Shartum, 1987). Another much discussed effect is the redundancy of large numbers of middle managers; computers have tended to flatten the administrative pyramid by eliminating the need for middle management layers.

However, centralisation trends ceased to be a technological imperative after smaller machines and more versatile software reached the market. Moreover, organisations facing ever fiercer competition sought more effective organisational structures and processes. IT has been understood as an 'enabling' technology, meaning that it can be used to contribute to the realisation of some desirable organisational form.

The most established ways of organising production and sales, such as bureaucracy and scientific management have been questioned and often severely criticised as inadequate to cope with the demanding business and administration environment of the post-seventies era. Various new organisational forms have been suggested. Mintzberg (1979) neatly classified this variety in five 'ideal types': the simple structure (entrepreneurial form), machine bureaucracy, professional bureaucracy, divisional form, and adhocracy. More recent models are the 'matrix organisation' (Bartlett & Ghoshal, 1989), the 'networked organisation' (Powell, 1990), the 'learning organisation' (Drucker, 1988), and others. IT is considered to play a critical role in the realisation of all these models. While there seems to be wide acceptance that organisations are changing, and the proponents of the new types of organisational model argue about their appropriateness to today's socio-economic conditions, empirical evidence suggests a much less clear picture about the prevailing new organisational forms. For example, based on longitudinal case studies in USA firms, Applegate (1994) concludes by suggesting *"the emergence of a new "information enabled" hybrid organisational model that marries features of the hierarchy, entrepreneurial form, matrix and adhocracy in unique ways"*.

Nevertheless, there is no shortage of hype, not only on what sort of changes organisations should aim to achieve by applying IT, but also on how to approach change. Business process re-engineering is the latest and currently most influential of the suggested approaches (Hammer, 1990). While many business firms and government institutions seek radical change by following the principles of business process re-engineering, many argue that the enthusiasm it has created is hardly justified (Jones, 1994).

In short, looking beyond the hype, the literature on organisational change and IT suggests that there is no specific organisational model that is tightly related with the IT available today. There is some generally accepted 'good advise', such as: don't use IT for automating jobs, and controlling employees, use it to 'informate', i.e. to empower employees by providing information that makes it possible for them to play a more substantial role in their organisations (Zuboff, 1988), although the extent to which such advise is put to practice and whether it leads to business success is not clear. While most writers on organisational change tend to focus on the new emerging forms enabled by IT, Kraft and Truex (1994) make the point that many of the companies of the USA discussed in the literature of organisational change only design and sell products; the production process tends to be sub-contracted to firms in developing countries which apply traditional bureaucratic and Tayloristic processes to achieve the degree of efficiency that allows them to be competitive, thus *"preserving the old system in the name of transforming it"* (phrase from David Noble quoted in Kraft and Druex, 1994).

There is no organisational imperative that accompanies the application of IT. IT can support successfully as diverse organisational forms as huge corporations and clusters of small enterprises. Considering the possibilities presented by new IT, some analysts speculate the emergence of socio-economic conditions in which large multinationals will dominate (Castells, 1989), and others put forward theories about 'flexible specialisation' characterised by the prevalence of regional co-operatives of small business organisations (Piore & Sabel, 1984).

Nevertheless, training in western business schools and consultants tend to attempt to transfer particular organisational models as the way to exploit the potential of IT. Sometimes these are old 'rational' forms, such as bureaucratic control and efficient fragmentation of responsibilities. In other cases they may be the latest hype. Unless it happens that the suggested change makes sense to the organisation concerned, the effort is wasted. More importantly, the use of IT is frustrated, adding to the inferiority syndrome about lack of ability to master new technology that prevails in many developing countries.

5. An example of unsuccessful application of methods

In the early 1990's Petrolatino[1], a large state corporation in a Latin-American country, went through a major organisational reform. This reform involved loosening of government administration and the introduction of business management practices, splitting of the corporation into four almost autonomous companies, along the lines of products and services they produce, with independent business management. To achieve this transformation the government relied heavily on American consultants, who designed the overall structure of the corporation and the structure of each of the new companies that comprise it, and they specified the tasks each of them has to perform. Information and IT management were given a great deal of attention and were assigned to be part of the responsibilities of top management in each of the new independent companies.

Each of these four new companies inherited part of the IS resources of the old corporation, and had to make provisions to cover a large range of requirements. The case of Petrolatino Oil, one of the four new companies, is indicative of the difficulties of transferring methodical planning practices. The director of information and IS employed an IT manager who had a degree in business studies, technical expertise in new technologies acquired partly by training in the USA and partly through practice, and long time experience in managing systems development projects within Petrolatino.

The first job that the IT manager undertook was the formulation of an IS strategy and the setting of an IS management capable of supporting the realisation of the strategy. With full support from his boss, he talked to all other directors and many managers of the company, he applied methods of proven validity, such as critical success factors, and aligned plans for IT investment with the company's expressed business objectives. The strategy he proposed was based on the premise that in order to be competitive in the world oil market the company needed information systems at least as good as those of their competitors.

A major objective was the development of an integrated IS infrastructure which would be able to provide management with accurate and reliable information. To achieve that, a portfolio of applications for the production, distribution and management tasks were proposed, and an overall plan to integrate them was designed. The proposed plans were expensive, both in terms of hardware and software development, as they aimed at installing computer terminals at all production and distribution sites and offices and at equipping all workers with hand-held devices for accessing the database.

The proposed strategy was accepted without anybody challenging the validity of its objectives or the urgency of the proposed applications portfolio, and it was approved by the director general. There was some concern about the cost and the way the strategy could be implemented. However, it was accepted that, although expensive, the proposed IS infrastructure was a crucial investment which the company ought to make, and at present it seemed that it could afford it. As for the implementation of such an ambitious strategy, the IT manager designed an IS management structure which shifted ownership and control of the development of applications to user departments. At that time user departments had little IT resources, both in terms of computers and staff, but new appointments were made and each user department established its own IT unit. Also, it was intended to subcontract most of the development projects. The IT manager's department retained responsibility for the design of the integrated systems model, applications to provide data to top executives, methodological standards, technical support to all IT units, and collaboration with sub-contractors.

Two years later the company had made little progress towards the realisation of the strategy and dissatisfaction with the poor IS infrastructure was rapidly growing in all parts of the company, from the director general office to the production sites. The director of information and IS was wondering what went wrong. He believed that the IT manager had done 'the right' thing. In fact, a revision of the strategy and the IS management structure by external consultants confirmed that the way they acted was what IS management textbooks suggest. The procedures that had been followed and the plans that were made were in accordance to the latest knowledge of 'good practice'. However, they did not seem to be effective in this company. A number of aspects caused concern.

The various departments were frustrated as they found it impossible to follow the 'integrated systems' design of the IT manager. As a result, those which had adequate skills went ahead with their own requirement specifications, ignoring the requirements for an integrated system that the IT manager and his team were trying to

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[1] For reasons of confidentiality we do not use the real name of the company.

draw. They felt that the IT manager and his staff were constraining rather than supporting them. However, those departments which did not manage to acquire the necessary systems development skills could neither take initiatives to over pass the proposed specifications of the IT manager, nor to collaborate with him to work out their requirements, and they continued to lack even the most fundamental applications for their functions.

A clash of cultures was detectable. Many departments were more willing to entrust their systems development to their engineers - engineering skills were abundant and highly valued in the company - who were quick in acquiring software development competence, than to the IT manager who had adopted a 'business' language and was introducing a new ethos. Many managers were highly suspicious that the apparently 'democratic' IS management structure was a mockery, and that the IT manager's department had too much power.

Concerns emerged about the adequacy of the proposed systems to support top management. Apart from the question whether an integrated system capable to supply information for the needs of all management was feasible, the director of information and IS began to question the role of such a system in the company's management. Within the two years of life as an 'independent' company, it became apparent that a number of aspects of the company did not materialise in the way it was presented in the initial design. Top management continued to be partly politically driven - after all they were not completely independent, they were part of the larger corporation which had to comply to targets set by the ministry. Within such a management context, executives continued to rely on the old, partly bureaucratic and partly informal, information channels and planning mechanisms. They all agreed that they needed to establish new indicators of performance, new ways of business planning, and more efficient communication channels between production and distribution sites and top management, however they were reluctant to abolish existing mechanisms which, although *ad hoc*, they were familiar and well trusted.

Also, some departments were still struggling to establish effective business functions. For example, sales and marketing were largely new activities which the company had to organise in parallel with, rather than by replacing, the ways of reaching customers that were inherited by the old state company. Business objectives and practices were not so clear after all. No wonder the IS strategy, which was formed on the basis of stated business plans, was not very effective.

It became apparent that the way 'good practice' knowledge about IS planning and IS management was applied in the company was totally artificial, it failed to capture the complex situation faced by the company, and it led to non-realisable decisions. As a result the company followed frustrated efforts, which hindered the development of even the most fundamental information systems. It is interesting to note that initially no reservations about the proposed strategy was expressed. The managers of the company considered that both organisational design and the IS strategy are matters for the expert. Of course, many doubts were lurking and a great deal of activity at the first period of the company's transformation was informal and *ad hoc*. The IS expert's approach to apply the established 'best practice' failed to cope with the complexities of the real situation.

6. Conclusions

Within a changing global economy, developing countries face the need to acquire a powerful technology which originates and has been developed for the organisations of advanced industrialised countries. In addition to the difficulties they face to find the financial resources for importing the new technologies, a main problem is how to exploit a technology which, although it carries an enormous potential, if not appropriately applied alienates rather than empowers a society.

Technology has reached a great variety of forms, allows for many different types of application and can be tailored to serve the requirements of very different contexts. There is great choice in hardware and software products which are highly flexible to serve as diverse objectives as centralisation or decentralisation, control or emancipation. However, there is much less flexibility in the way we think about its use and the practices we adopt to utilise it.

As a critical mass of computer hardware and software becomes available in developing countries, efforts are made to systematise their utilisation and increase their payoff by transferring the business practices and systems development methods prevailing in western countries. While this may be feasible in a number of organisations, the effectiveness of such transfer should not be generalised. Organisations may have more to gain from experimenting with both types of technologies and ways of applying them. To do so, even fundamental principles for the utilisation of technology, such as the principle that hardware and software are developed only after an analysis which

determines the exact requirements of the organisation, may have to be reconsidered. Indeed, this logic is not necessarily useful. A number of organisations in developing countries find it more 'natural' to acquire the equipment and adapt it to their practices, rather than specify their requirements in advance. In such cases technological flexibility is more important than rigour of specification and development method.

In this paper we have argued that organisations in developing countries should be cautious when they adopt systems development methods and try to introduce organisational change by means of implementing IT based information systems. Apart from the techniques for the very technical tasks of systems development, such as design and programming, systems development methods constitute systematic attempts of organisational intervention. As such, their effectiveness vary within different socio-organisational contexts. Moreover, today's IT is not linked deterministically with any particular organisational structure or work procedures. While it is true that the greatest benefits from IT stem from the possibilities it opens for organisational change, developing countries should be aware that there are no recipes for successful organisations.

These are areas where developing countries need to foster indigenous research. To that end, theoretical efforts that have been made in the West to understand the nature of IS and organisational change (Boland & Hirschheim, 1987; Galliers, 1992; Walsham, 1993), can provide useful insights to developing countries too.

To the extent that Odedra's conception of technology transfer as education is valid, the transfer of understanding of the nature of IS, organisational change, and IS development can be much more effective than the transfer of packaged organisational practices, such as SSADM, or Critical Success Factors. University curricula should develop the capacity of practitioners to organise systems development practices which can be effective in their organisations.

An obvious drawback of such an approach is that it does not offer a short-cut to effective exploitation of the capacity of IT. There is no evidence that such short-cuts are possible. To the contrary, there is a great deal of documented and anecdotal evidence that expatriate consultants fail to deliver the expected results. Without considerable indigenous experience, rationalisation efforts such as on what systems to be developed, how they should be managed and how they should be developed, are imposed from the outside, and may be inappropriate in the country's context.

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Computer systems development for 'delinking' in Nigeria?

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Abstract
Every fifth Sub-Saharan African is a Nigerian, and every fifth computer in Black Africa is installed in Nigeria. My DTech study aimed at providing a broad theoretical framework for studying the work practice of Nigerian systems developers as an endogenous process which may generate relevant experiences for smaller African countries as well. The study consisted of an explorative action research part (a joint project with Nigerian academic computer scientists and a University Teaching Hospital) and a theoretical part. The study resulted in a multidisciplinary research framework linking together supra-societal, societal, organizational, and work-activity levels of analysis. On the highest macro levels, underdevelopment in Nigeria was studied using Samir Amin's and Claude Ake's theoretical propositions.

A tentative analysis of the computer-related activities in Nigeria suggests that two modes of the activities co-exist. The prevalent mode, 'sell and run', reflects the dependency of Nigerian society. It is focused on hardware sales, creates a comprador group of businessmen, and has little to contribute to basic needs or national self-reliance. However, there seems to be another trend, too, which pays more attention to systems development and which is based on 'serious entrepreneurs' and 'serious professionals'. This trend may contribute to an auto-centred or 'delinking' path of development, as defined by Amin. At the same time, this trend benefits from all steps in the 'delinking' direction, and all obstacles to 'delinking' are also obstacles to 'serious systems development'. The opportunities for 'systems development for 'delinking'' should be further studied and developed by a multiprofessional, cooperative project comprising Nigerian systems development practitioners, academic computer scientists, sociologists and political economists.

1. Introduction

Computer-based information systems are not developed in industrialized countries only. However, there are only a few empirical studies or case reports on information systems development (ISD) in Africa for instance (see Adelakun (1993) and Forster (1993) for exceptions).

Some studies try to draw lessons from European ISD for Africa — Braa, et al. (1993) provide an inspiring example. This study has the opposite goal of trying to learn from Africa. It is assumed that in Africa the context of IS development and use is much more demanding than in industrialized countries. Therefore, by studying the practice of the systems development work in an African country one might get confronted with fundamental issues of the very profession.

The first part of this paper provides empirical material of the study by narrating the author's own experience in a joint Nigerian-Finnish Hospital Information System project, and by presenting some information on ISD in Nigeria by Nigerians. The second part considers several theoretical frameworks which could be useful in analyzing the empirical material. It is argued that a multidisciplinary approach is needed. Therefore, research traditions are examined in four fields, namely information systems development, health informatics (the application domain in question), work research, and development studies.

The outcomes of the four theoretical surveys are integrated into a single framework. The framework is illustrated by applying it to the empirical case setting. Finally, the need for further research is indicated.

2. The empirical exposure

The author embarked on postgraduate studies on ISD in Africa in 1985. The Computer Science Department of Obafemi Awolowo University (OAU), Ile-Ife, Nigeria, invited him for a two-week planning visit in 1988. As he

had prior experience in hospital information systems (HIS) and the OAU Teaching Hospitals Complex had at the same time decided to 'go computer', a joint HIS project was established.

During the author's 10-month stay in Nigeria in 1989, a very basic, relatively low-cost HIS was jointly designed (Korpela, 1990). The Computer Science Department established a group of staff to continue with the HIS technology. The hospital purchased a microcomputer and terminals the following year, and the system has been in operation since 1991 (Daini, et al., 1992).

Close cooperation between the author, the hospital and the OAU Computer Science staff continued through intensive correspondence and two short visits. A point-to-point electronic mail link from University of Kuopio to the OAUTHC was established in 1992, speeding up the correspondence considerably, although at an increased cost. Each institution has paid its expenses in the joint project from its budget, without external funding. The Nigerian-Finnish cooperation culminated in jointly organising the first international conference on health informatics in Africa (Mandil, et al., 1993).

Today a significant expansion of systems development activities in Ile-Ife, and of the system itself, is in the planning. The project participants agree that although the basic system has proved viable and eased the burden of statistics, it does not provide sufficient clinical benefits. Both short and long term extensions are planned in order to increase the system's health impact.

To achieve the more ambitious objectives, the HIS team at the Computer Science Department needs much more time and resources for systems development. However, this is impossible without an external source of funding. In the long run, selling the HIS software and support services to other hospitals in Nigeria would be the solution but governmental or international funding is needed for the development phase.

The author collected supplementary information about the state of ISD in Nigeria from newspapers and by a few interviews of Nigerian systems developers working in computer companies of various sizes (Korpela, 1990). Although there are hundreds of computer companies in the country, most of them concentrate on selling hardware and packaged software. The computer professionals considered software and systems development important but not profitable in itself. Problems with electricity, telecommunications, bureaucracy, lack of awareness, and foreign exchange acquisition were mentioned as the main obstacles of work.

The interview material which Olayele Adelakun has collected about hospital informatics in Lagos, Nigeria, corroborates the view (Adelakun, 1993).

3. Theoretical frameworks

How can one analyze empirical material on systems development from a developing country, for global lessons? Moreover, what kind of theoretical frameworks are needed? Before an attempt is made at answering these questions, one has to remember that 'developing countries' is a concept of the social sciences. If one wants to discuss a 'developing-country phenomenon', one needs to explicate one's social-science framework of what makes some countries 'DCs' and how they became such, and what is the difference between the twin concepts of a 'DC' and an 'industrialized country'.

On a micro level, one will need a framework for conceptualizing information systems and ISD. In order to keep the perspective somewhat to the ground, the domain of application in question, i.e. health informatics, requires special consideration. To link the macro and micro levels together it is useful to consider ISD as just one example of work, although one which has much to do with technology. Frameworks dealing with the use of technology in work will therefore be considered.

A multidisciplinary but integrated approach is thus unavoidable. Potential frameworks are surveyed in the following sections, advancing from the technical to the societal. The survey has a clear emancipatory knowledge interest — i.e, it is considered that theoretical constructions should not only provide explanations to the phenomenon of 'systems development in health care in Nigeria' but be potentially useful in making things better.

3.1. Information systems science: phases and traditions

Andrew Friedman has proposed that ISD in Europe and North America has gone through three phases, each of which was characterized by a different main constraint or problem — first the hardware constraints, then the software development bottleneck, then the user relations (Friedman, 1989). Jørgen Bansler, on the other hand, has identified three traditions which have existed in (Scandinavian) ISD theory. They are the systems-theoretical, socio-

technical and critical traditions (Bansler, 1989). The same broad traditions can be found in other countries as well, although the popularity and specific theoretical propositions of the 'hard', 'soft' and 'critical' brands are different in Scandinavia, Britain and USA for instance.

Combining Friedman's and Bansler's views, we can see ISD enlarging its scope from technical to usage issues, and simultaneously splitting apart into more and more distant brands. The differentiation is a consequence of ISD becoming more involved in issues of social nature which are subject to conflicting interests. Different traditions are for different stakeholder groups in the workplace. Bansler explains the emergence of the traditions by starting from the double nature of work as 'production of use-values' and 'production of surplus-value' at the same time. The objective of systems development, then, is profitability (surplus value) for the systems-theoretical tradition, usability (use-values) and worker interests for the critical tradition, and a reconciliation of the two for the socio-technologists (Korpela, 1994).

The stakeholder groups important to ISD within an organization include the systems developers themselves, the management, the 'end-users' operating the information system, and other indirect beneficiaries, victims or clients of the IS. Thus computer-based information systems can supposedly be divided into management-, worker- and client-oriented ones (MIS, WIS and CIS). The design process may be controlled by the same stakeholder group, whose objectives are supposedly in the focus of the design ('democratic design'), or by an external 'expert' group.

The definitions of information systems and ISD differ according to the phase and tradition. The strong phase-2 legacy in IS science causes a bias towards taking ISD as almost equal to software development. For a WIS-CIS orientation, instead of separate 'information systems' one should think about computer-based facilitation of work. Thus ISD should be redefined as the *facilitation of the purposes of a work activity by computer technology*. It cannot be reduced to software development, neither to work design, but it usually contains elements of both. A WIS-CIS systems developer will start from the needs of the 'users' and 'clients', find existing pieces of hardware and software, mix and modify them, create new software when necessary, and embed these to the rest of the instrumentation of work.

3.2. Information and technology in health care

As the empirical material of the study is from the health care domain, established theories on the role of informatics in health care were reviewed. Even an authoritative recent textbook by Shortliffe and Perreault (1990) does not provide an integrated theoretical framework for the discipline. Rather, 'health informatics' is defined as the application of information technology in health care, and the more limited concept of 'medical informatics' correspondingly as the application of information technology in medicine.

However, health care is particular as a domain of activity in the sense that its objectives are more pointedly 'social' than in many other domain. Even in the most bureaucratic or profit-driven settings it is hard to imagine health care without an objective to care and cure. In developing countries the social objectives are even more visibly present. Consequently, it is reasonable to suggest that in the application of information technology in health care, the social (health) impact of the technology should attract special consideration. In much of the literature on health informatics in developing countries there is general agreement on this issue (Forster, 1990; Wilson, 1989; Mandil, et al., 1993).

Any major attempt at introducing computer systems (or any other technology) in health care should thus start by analyzing the social objectives of health care itself, in the country or community in question. The objectives for the systems development should then be derived from the social objectives. Such an analysis is not presented here (see CHRD (1990) for a compact overview) but some possible methodological tools for the analysis are discussed in the following section.

3.3. Research on technology in work

The redefinition of ISD in an earlier section implies that more emphasis must be laid on conceptualizing and studying work in general, and the kind of work to be facilitated in particular. Activity Theory is a less widely known body of theory operating on the boundary area between psychology and social sciences. In Finland, an activity-theoretical approach on work development, called Developmental Work Research (DWR), has been widely applied (Engeström, 1987, 1991). One of the underlying conceptual premises of DWR is a model of the structure of human work activity. A modified version is presented here (Korpela, 1994).

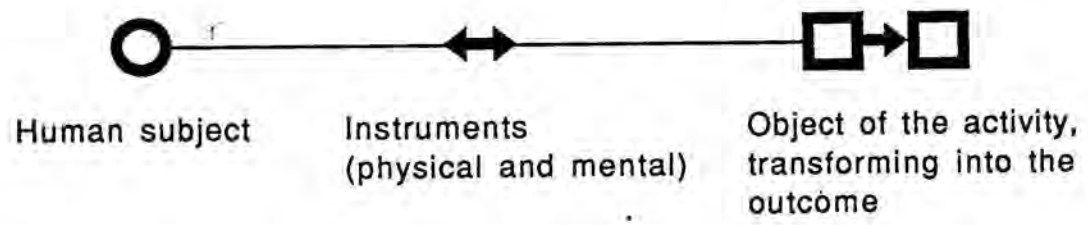


Figure 1: The relation between an individual human subject and an object of work, mediated by instruments.

The model starts from the core assumption of activity theory that the relation of a human subject with an external object is always mediated (figure 1). In an individual action of work, the subject makes use of various instruments — physical and mental. The work's object is also its motive, in the sense that during the work process the object is transformed into the outcome of the work. For instance, in a primary health-care activity a physician (subject) uses hands, laboratory tests, textbook knowledge, tacit skills, etc. (instruments) in working on the patients' health problems (object). During the work the health problems are expected to transform into improved health (outcome), which is the motive of the health-care activity — the reason why the latter exists as a relatively stable social formation, an activity.

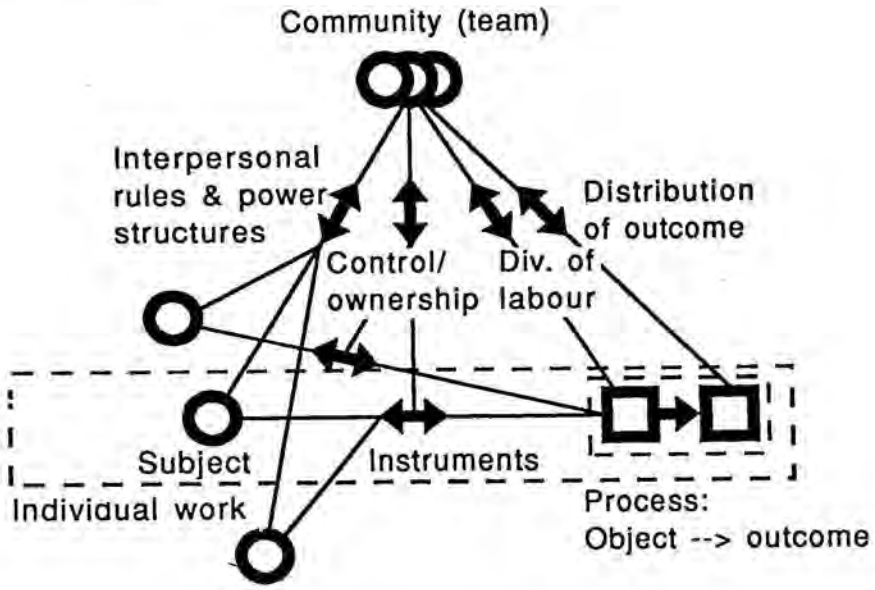


Figure 2: The structure of work activity, modified from Engeström (1987)

The physician in the above example is not the only person working on the patients' health problems. Work in real life is always collective, in the sense that several subjects need to work on the same object (not necessarily at the same time and space) in order to transform it into the desired outcome. Those working on a common object are called the community or team of the work activity (figure 2). The relations amongst the community are also

mediated, by social instruments. Inter-subjective relations are mediated by rules, power structures and means of communication. The sharing of the object amongst the community is mediated by the division of labour, the sharing of instruments by the means of control and ownership, and the sharing of the outcome by still another set of social instruments. In studying a collective work activity, it is necessary to investigate the characteristics of each constituent element and the systemic whole in which they are more or less in a dynamic balance or contradiction with each other.

Work activities are not self-contained entities, in the sense that their outcomes are consumed in other activities, and they themselves need inputs from other activities (figure 3). For instance, it can be argued that the object of health care is not just diseases and symptoms but the life activities of the 'patients' or of the community in question. That is, health care produces ingredients for better life for the community it serves. Likewise, a health care activity needs instruments produced by some other activities, its subjects are 'produced' by educational and training activities, and its 'social instruments' by management, government, trade unions, etc.

Developmental Work Research is primarily a pragmatic approach for the subjects themselves to analyze their work activity for an 'ethnography of trouble' (Engeström, 1991), with an aim of identifying an improved mode of work activity which can be reached from the present one. DWR's theoretical premises, presented above partially and in a modified form, appear highly potent in relating individual and collective aspects of work into an integrated framework suitable for work-oriented ISD. However, DWR theoreticians have not elaborated much on the wider societal conditions of work.

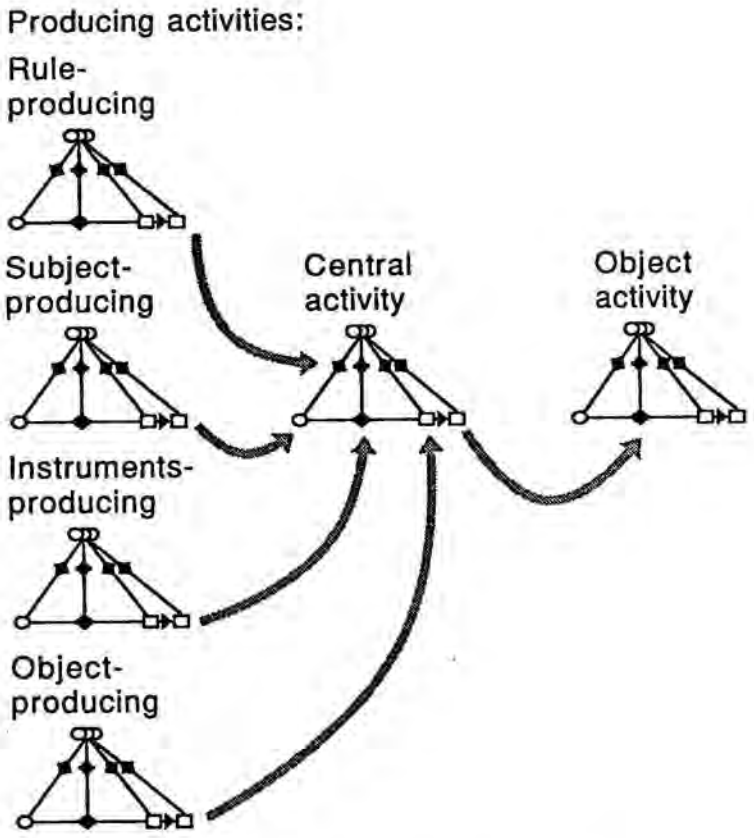


Figure 3: A central activity with its object activity and producing (supporting) activities, modified from Engeström (1987)

3.4. Development and underdevelopment

Any study on a developing-country phenomenon should explicate its definition of 'developing countries' and its view of the causes of the division of the world into developing and industrialized countries. Most of the existing scientific literature on informatics in developing countries, for instance, seems to implicitly adopt the 'developmentalist' or 'modernizing' assumption that the developing countries are essentially late-comers which will follow the path showed by the industrialized countries, and that the reasons for 'lack of development' are in the developing societies themselves — i.e., the 'traditional' cultural values in the developing societies do not appreciate enterprising, etc. (cf. Avgerou & Land (1992) for an otherwise inspiring analysis).

An alternative explanation was offered by the so called dependency school more than twenty years ago and has since been developed into less mechanistic orientations (see Roxborough (1979)). In essence, this brand of thought maintains that today's developing countries were drawn, at various points of history, into an unequal global economic system which underdeveloped them in relative terms, and which continues to reproduce the relations of dependency. The less mechanistic and deterministic derivatives of this approach emphasize that the external relations of dependency tend to create an internal social structure which reenforces dependency. Thus, dependency was initially established by an external macroeconomic condition but it is perpetuated by an internal political regime (Ake, 1991).

The underlying view of the root causes of underdevelopment will determine the strategy for breaking away from the present situation which is universally regarded intolerable. If developing countries are seen as junior ones which suffer from disabling 'traditional values', then the strategy is a quantitative one — more enterprising, more technology, more investments, more education, more 'western values'. The Structural Adjustment Policies enforced by the International Monetary Fund fall into this category. An alternative strategy would be to 'delink' from unequal global relations and turn the focus of social development towards internal needs (Amin, 1985/1990; UN ECA, 1989). The third possible strategy, based on a rejection of 'development' altogether, would be to turn back to small-scale, 'traditional' ways of community life.

In order to contextualize the theoretical and strategic approaches, this author studied Nigerian and West African history and political science. As the empirical case took place in the Yorubaland part of Nigeria, a wealth of literature on Yoruba Studies was also surveyed (see Asiwaju (1983) for a brief introduction). If the 'modernizing' theory is correct, the root causes of Nigeria's 'underdevelopment' — and of the obstacles of systems development identified by Nigerian professionals — should have been found in the traditional values of the Yoruba (and other ethnic groups in the country). Nothing in the literature supported that hypothesis (Korpela, 1994).

In the historical material, the origins of Nigeria's current problems could be identified in the slave trade — not so much directly because of the loss of human resources but because it turned the societies concerned away from productive activities to middleman economics, and created a state of social insecurity (Olaniyan, 1985). The colonial rule then was undemocratic by definition. It created a model of government by coercion, and of the parasitic state as the most profitable form of an economic activity. According to Claude Ake, the alienated colonial state was retained as such at independence, and politics became more and more a war about the spoils of the national revenue. It is then natural that the military, the professionals of violence, have flourished on the field of 'politics as war' (Ake, 1993).

The survey suggested that the most convincing explanation for the present state of affairs in Africa was provided by African political economists, Samir Amin and Claude Ake particularly. To break away from dependency, they emphasize the redistribution of power and wealth, popular participation in decision-making, and an economic policy turned towards serving the ordinary man and woman. This, they observe, is no easy task, and will not be effected by the social forces which benefit from the present state of affairs, domestic and foreign.

The issues above are more relevant to systems development than might be immediately obvious. If the economic efforts of a nation are geared towards debt servicing, parasitic gains through political power, and middleman economics, then the computer-related activities will also be geared towards earning the quick buck by hardware sales without indigenous systems development. On the other hand, the alternative strategy proposed by Amin, Ake, UN ECA and the likes, would imply a strong shift towards participatory systems development oriented towards empowering and serving the ordinary man and woman with the computer technology.

It can even be argued that the alternative strategy is not possible without indigenous technical (agricultural, engineering, managerial, but also computer-related) capabilities oriented in socially prioritized applications. To

Samir Amin, 'delinking' does not mean autarchy, but a new order of priorities, based on popular democracy, technical skills, infrastructure, equitable international links, and most importantly, on social forces which are interested in endogenous development.

4. Framework for analyzing 'activities in societies'

The theoretical surveys in the previous section suggest that work activities and the macro society are the two key levels of analysis required in studying information systems development in a developing country — or in any country, for that matter. Moreover, the two levels need to be interlinked. Such an interlinked framework for analyzing the empirical case of the earlier section is presented in figure 4 (Korpela, 1994). A sketchy application of the framework to the empirical case is presented in figure 5.

The framework is operating on various levels of scope. First, the activity-theoretical concepts and techniques of DWR are used in analyzing the central activity in question. In practical ISD, the central activity is the one which is to be facilitated by the would-be IS. In IS research, on the other hand, the central activity of analysis is the practical ISD itself.

Applying the former approach to the empirical case, we can maintain that the Medical Records function of the OAUTHC is the central activity to be analyzed (figure 5). The subjects, instruments, object(s), rules and community of the Medical Records activity can then be discussed by the systems developers and Medical Records staff, for an 'ethnography of trouble' perceived in the present mode of work.

'It is then important to analyze the network of supported activities. In the empirical case of the OAUTHC Medical Records activity, it can be seen that the outcomes of this activity are needed in several other activities, ranging from the direct patient care, through the research, training and education of the hospital, to the statistical activities of the Federal Ministry of Health. The motive or the 'purpose of existence' of the Medical Records activity is to serve its object activities in the best possible way under the current circumstances.

In order to find the 'best possible way', we need to analyze what is the 'purpose of existence' of the object activities. For instance, the in- and out-patient care activities in a hospital serve the communities in question directly by producing 'better health', but also indirectly by providing specialist services to the Primary Health Care. Thus the Medical Records activity needs to facilitate the direct patient care activities in such a way that the latter can facilitate the communities and the PHC in the best possible way.

In general, it is suggested that the second-order supported activities determine the objectives of the central activity. By considering their present mode of work and the objectives determined by the supported activities, the Medical Records staff can try and imagine an improved mode of their work activity. The latter may simply imply a new orientation to the work, or some modified work procedures or rules, some new education for the staff, but maybe also some new computer-based instruments, i.e. an IS.

If an IS would be required, it is then important to analyze the network of producing activities needed. In our empirical example, the Hospital Information System needs electricity, hardware maintenance, consumables, application software, and so on. These are provided by a wealth of activities, partly within the hospital, partly outside of it (hardware vendor and the HIS development group of the Computer Science Department, OAU). The supporting activities also need to be supported by another set of activities; for instance, the systems development team may need some international consultation on some problematic technical issues.

In general, it is proposed that the sustainability of the IS under consideration is determined by the existence or successful implementation of the network of supporting activities. That is, the supporting activities must exist, or they must be established. Otherwise the IS cannot be sustained in the long term, and therefore should not be implemented at all.

The procedure sketched above is in accordance with the client-oriented approach of ISD, with the Primary Health Care policy of the World Health Organisation, and with the 'delinking' strategy of national development. It can thus be concluded that the DWR approach fits well with the three other viewpoints surveyed earlier.

The activity-theoretical framework deals with the 'metabolism of use-values' within a society. However, it does not cover the other aspect of the double nature of work (cf. Jørgen Bansler in an earlier section). In order to analyze the financial aspect, we need to expand our level of scope from activities to organizations (enterprises, institutions, NGOs) and financial transactions (figure 4).

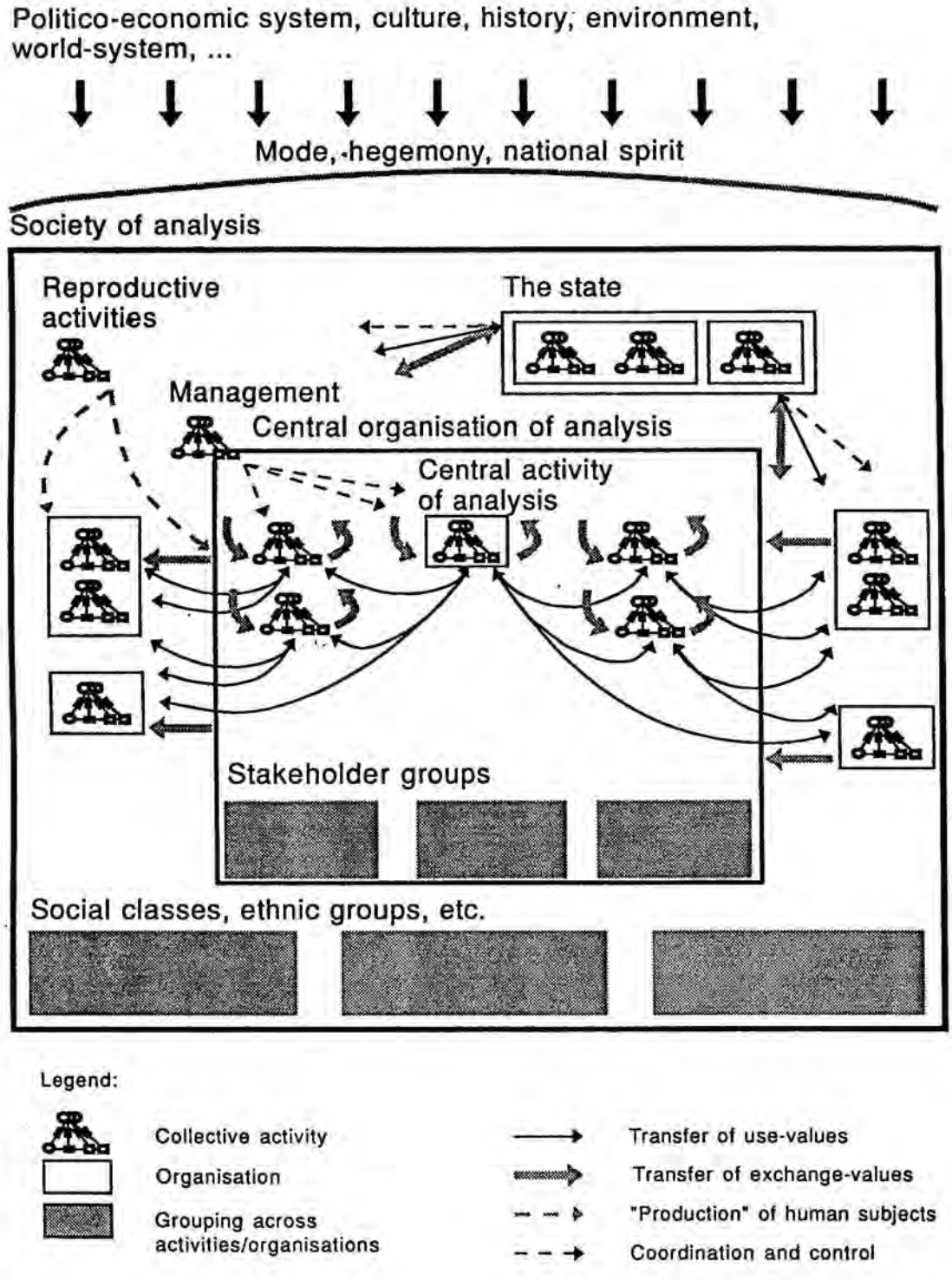
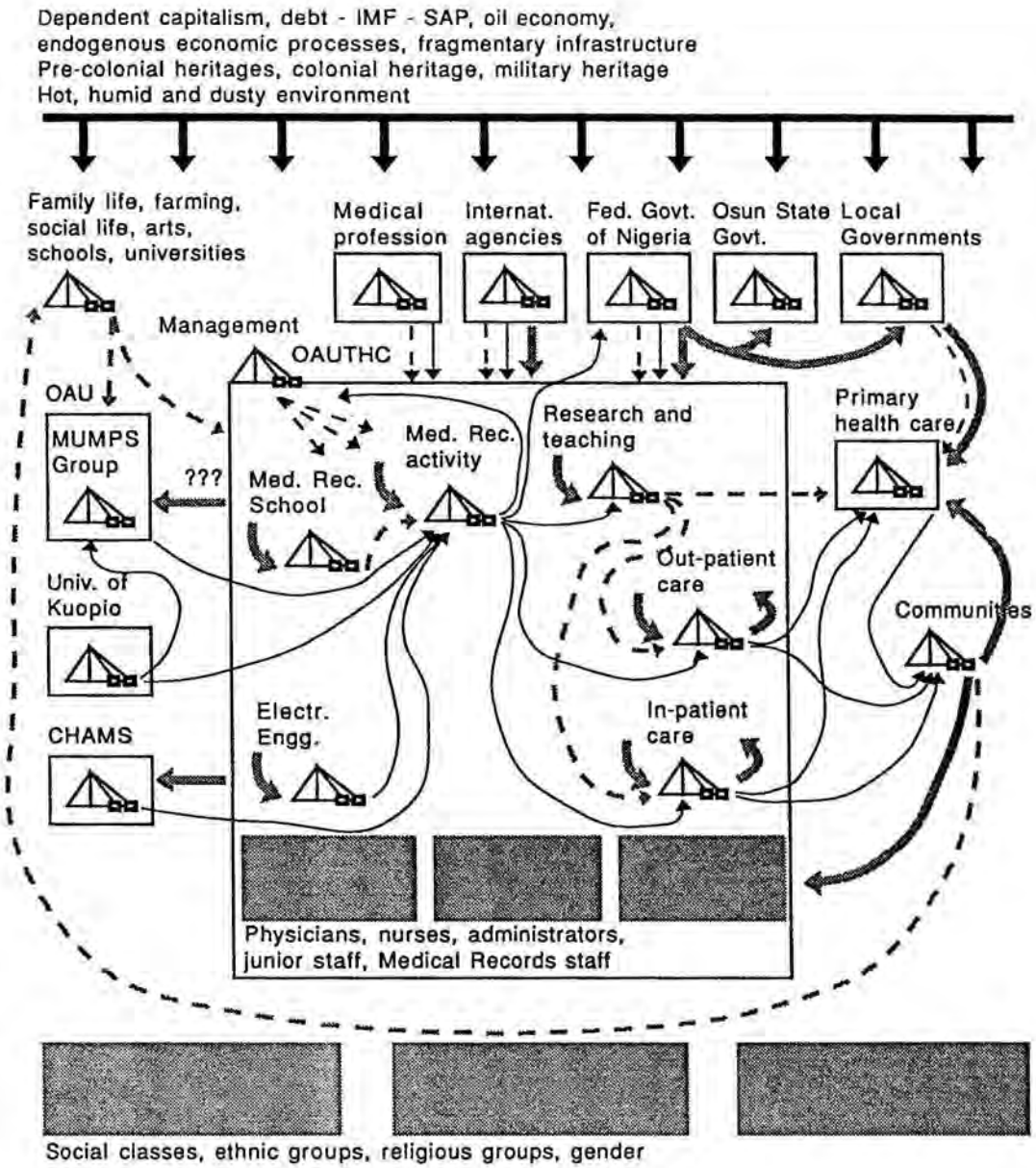


Figure 4: Framework with levels of scope: activity, organisation, societal, supra-societal



Contradictions, conflicts, problems:
- Dependency vs. endogenous economy
- Quick profits vs. basic needs
- Politics as war on spoils vs. democratization
- Multiethnic federacy vs. ethnic balkanization
- Deficiency of industrial fabric
- Aid/oil vs. sustainable funding
- Preventive vs. curative care
- Statistics for above vs. support for care

Figure 5: The theoretical framework applied to the empirical case

In a non-subsistence economy, all activities need financial inputs to survive and most activities also produce financial or exchange-values. In a market relationship the transfer of exchange-values coincides with the transfer of use-values, but that may not necessarily be the case in other kinds of settings. For instance, in a public health care system, a patient may receive health-care services apparently without paying for them. The state provides the funding for the health-care facilities and collects the funds from the population by taxing. Within organizations the allocation and appropriation of financial values is usually decided by the management, not by pure market relations.

Thus the activities and use-values on the one hand and the organizations and exchange-values on the other hand are separate but interlinked spheres. Organizational and financial studies are well established, so there is no need to go into details here. It suffices to say that the financial relations also need to be considered. For instance, in the case of the OAUTHC system, the systems development group in the Computer Science Department has been financed from the university budget but its long-term viability and preconditions to work might be greatly enhanced by a financial arrangement with the hospital. At least for the time being, the group has preferred to take the OAUTHC project as a research undertaking and to search for international research funding for it.

On the activity level of scope, subjects and inter-personal rules were studied. On the organizational level, different stakeholder groups, organizational structures, organizational culture, etc., are analogous concepts. For instance in a hospital, the doctors, nurses, administrators, etc., are groups which partly cut across the activities and which have their own specific interests, objectives and professional issues in mind. Similarly, if we applied the analytical framework to ISD as the central activity, we should also consider the organizational contexts and stakeholder groups in the ISD setting.

The level of scope of the framework can be zoomed out for one more step, to the societal level. The social sciences operate on this level and deal with categories such as social classes, the state, and so on. Individual societies are further conditioned by their natural environment, history, culture, political and economic systems, etc. The 'modernization' and 'dependency' theories operate on this supra-societal level.

The overall framework is not intended to be a grand theory of everything in the world but to provide a scheme for the application of various well-established disciplines in the study of ISD in its full contextuality. The specific theoretical propositions to be applied depend on the case under investigation, and on the researcher's paradigmatic assumptions. Furthermore, one or more of the higher levels can be taken as given depending on the case. For instance, when analyzing the ISD setting in a given hospital in a given country, it suffices to study the activities and organizations involved. However, if one wants to generalize about the nature of ISD in one country or group of countries then one needs to study the societal and supra-societal factors which may be involved.

Some possible factors which may characterize the Nigerian context are identified in figure 5. The list is very tentative indeed and although it is based on the works of Nigerian social scientist it is still an outsider's view. A fully developed picture-in-context of ISD in Nigeria can only be drawn by the joint efforts of Nigerian social scientists and IS professionals.

On all the levels of analysis, the researcher should not take the reality as static. There are always contradicting factors, conflicting interests and alternative paths. A few such issues, of various levels of scope, are listed in figure 5.

5. Tentative analysis of systems development in Nigeria

The study at hand was intended to provide a broad theoretical and exploratory base for further research, so it does not provide sufficient empirical material for reliable conclusions about endogenous systems development in Nigeria. However, a preliminary model can be presented (figure 6).

A tentative analysis suggests that two modes of the computer-related activities co-exist in Nigeria. The prevalent mode, 'sell and run', reflects the dependency of Nigerian society. It is focused on hardware sales, creates a comprador group of businessmen, and has little to contribute to basic needs or national self-reliance. However, there seems to be another trend, too, which pays more attention to systems development and which is based on 'serious entrepreneurs' and 'serious professionals'. This trend may contribute to an auto-centred or 'delinking' path of development, as defined by Amin. At the same time, this trend benefits from all steps in the 'delinking' direction, and all obstacles to 'delinking' are also obstacles to 'serious systems development'.

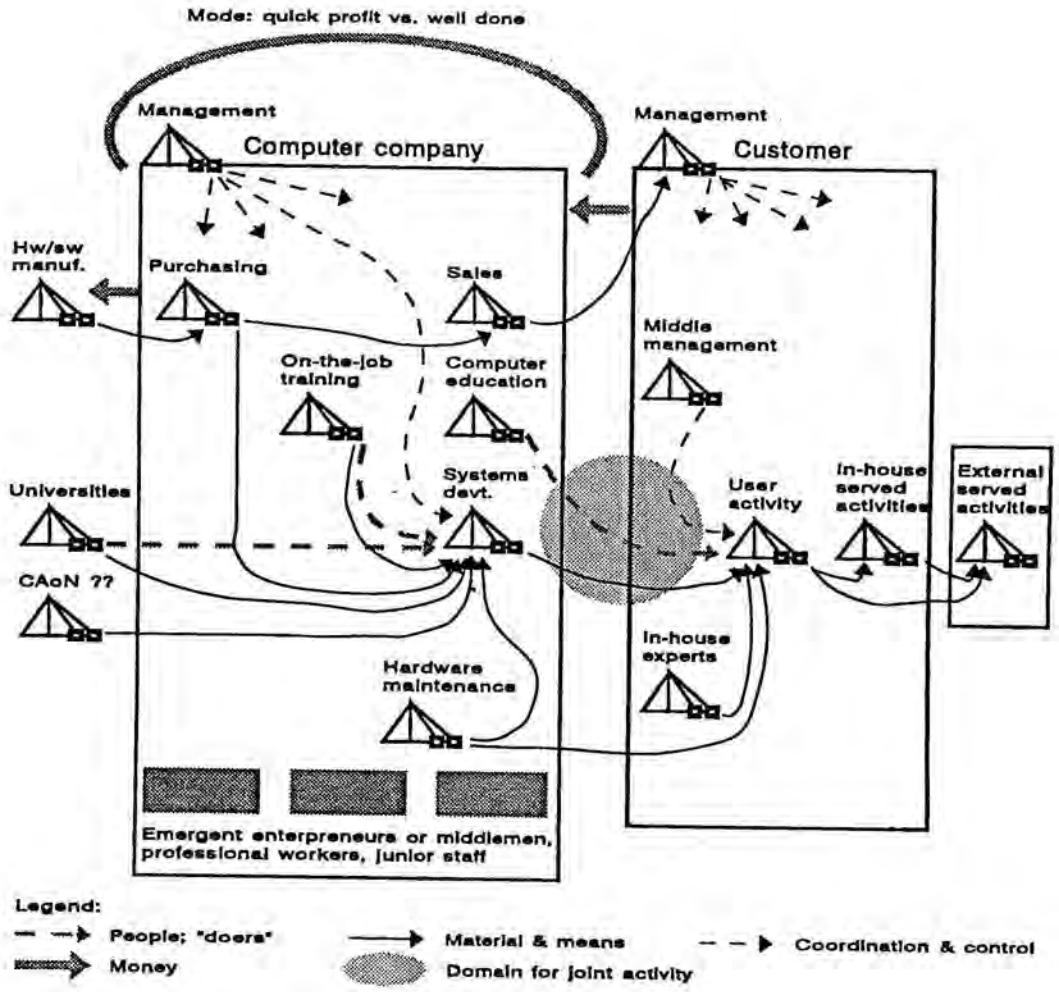


Figure 6: A general view of systems development in Nigeria

Can ISD in Nigeria contribute to the nation's future? Claude Ake's analysis would suggest that as long as the present politico-economic system persists, the obstacles of endogenous economic activities like systems development are formidable. However, there is a growing need of information systems which address the basic needs of the people. Such an ISD can have an impact on the empowerment and economic uplifting of the least well-to-do groups and thereby contribute to what Ake presents as the alternative path of development. The private computer enterprises may have a limited potential to this end, but educational and research institutions and civil-society organizations can be better catalysts of 'appropriate information systems'.

A major change in the country's politico-economic system, or in her position in the world economic system, would also change the prospects of societally relevant ISD. This simple observation — almost a platitude — further underlines the need of societal and supra-societal analysis in IS research.

6. Conclusions

Four general conclusions are drawn here from the analysis above. First, the analysis indicates that a multidisciplinary approach is necessary in understanding ISD in a given society and that the social sciences are particularly important therein. Against that background it is very strange that the societal and supra-societal levels are virtually lacking in European IS theory, not to speak about the North American brands.

It is of course only human to assume that the particular characteristics of one's own society are universal and can thereby be dropped out from the set of variables. The results of such research will yet remain particular, without the researcher being aware of it. The context sensitivity of the 'standard' IS science would therefore benefit from it if European and North American researchers familiarized themselves with ISD in the developing countries.

Second, developing countries cannot afford ISD for fun or for enriching a few; they need ISD that will cost-effectively address the basic needs of the people and as a by-product generate a sustained endogenous network of supporting activities. But should the case be any different in the industrialized countries?

Actually, what is the *raison d'être*, the purpose or justification for existence of computer-based information systems? Why are they developed? If not for cost-effectively addressing basic needs of people, what then? It is hard to imagine why systems which do not contribute to the basic needs at all should be developed in the first place.

I think lesson number one European systems developers should learn from the African setting is to assess the justification of their own work from a social perspective. This will force them to realize that currently systems development is more often directed by payable demand than by priority needs.

Third, about the driving forces of ISD. System developers tend to leave it to the 'forces of nature', i.e. the market forces, or payable demand, or 'one dollar – one vote', to direct the development. If priority needs are to be served, people without dollars should be given extra votes in ISD. However, European ISD theory has not gone very far in analyzing the different power bases of the different stakeholder groups of ISD, nor in finding ways of empowering the people who are the social carriers of priority needs.

Methods of analysis and values which pay attention to the social purpose of work (and information systems), like DWR for instance, will already make some difference. The direct representation of 'clients' and the public (or 'community' in developmental parlance) in ISD is a difficult issue. As a starter, the techniques used in user-centred approaches can be adapted to a client-centred approach — participation, pilot projects, work analysis, reflection, future workshops, etc. Indirect representation through activists, non-governmental organizations, Ombudsmen or elected local leaders could also be considered in some ISD settings.

Finally, what is the relevance of IS Science? The analysis of the Nigerian case above suggests that from a national or popular point of view, ISD is the most important one of the computer-related activities in a country. The IS Science is of course based on the more technical brands of Computer Science, even though it is grossly underrepresented in the academia.

Mahmood Mamdani, while reflecting on the developments in African universities after independence, has elaborated on the relevance of universities themselves. He first narrates how the universities strived after universalistic rigour in the science, and were put under pressure first by authoritarian governments and then by the narrow market logic of the IMF and the World Bank (Mamdani, 1993):

> *Driven into a corner, we discovered local communities, communities which we had hitherto viewed simply as so many natural settings. Forced to address these communities, we were compelled to look at ourselves from the stand-point of these communities. We came to realise that universities have little relevance to the communities around us. To them, we must appear like potted plants in greenhouses — of questionable aesthetic value — or more anthropological oddities with curious habits and strange dresses, practitioners of some modern witchcraft.*

I am not in a position to estimate if Mamdani does or does not accurately describe the situation in African universities, less so in the Computer Science Departments. To me, however, he has a clear message to the European and North American computer-related academia. The relevance of the universities and the research should be assessed from the standpoints of the local communities. IS Science has the potential of being highly relevant but the potential is not fully realized today.

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Decentralisation, primary health care and information technology in developing countries: Case studies from Mongolia and South Africa

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Abstract
Many developing countries are in the midst of a process of decentralisation of their governmental structures and of their health services. In this paper examples from case studies from Mongolia and South Africa are presented. In both countries central issues are the decentralisation of health service management, and a shift of focus from a curative to preventive care (i.e. Primary Health Care). Major obstacles in the reformation of health systems in both countries are the resistance to change by the strongly centralised structures and the curative biases inherent in the present health system. In the paper, methodological approaches to overcome these obstacles are discussed: evolutionary and participatory approaches to information systems development are recommended. Because a central issue in reforming the South African health system is community participation, it should be possible to extend this ethos to community participation in the development of information systems in the health sector.

1. Introduction

The process of decentralisation of governmental functions in general, and health administration in particular which have recently begun in Mongolia and in South Africa, is paralleled in many developing countries. The World Health Organisation (WHO) encourages decentralisation as part of its Primary Health Care (PHC) strategy to strengthen health management at local level. Local processing of data and use of this information in local decision-making is believed to be important in this process. Appropriate use of information technology (IT) may play a key role in this regard. Drawing on case studies from Mongolia and South Africa, the place of IT in the restructuring of the health system is discussed. The rationale is to look for similarities and differences between the two cases, and thus identify lessons that can be generalised and seen useful in a broader context. The point of departure is the experience of fieldwork in Mongolia. Mongolia is some five years ahead of South Africa in its process of radical change. I will use lessons from Mongolia in analyzing the process of decentralisation of the health sector and the role of health information systems (HIS) in South Africa. These can be summarised in three interrelated issues:

1 *Decentralisation.* A process of decentralisation of the health sector has begun. To be successful a corresponding decentralisation of information systems is required. In the developing world the health sector typically consists of different, vertically organised and independent institutions. These centralised organisations may be efficient in some respects, but the verticality makes integration at other places than at the central level difficult. A decentralised structure requires integration at lower levels. The strongly centralised and vertically organised health system and health information system in Mongolia presents an important obstacle to the on-going process of decentralisation.

2 *Biases in information and the needs of Primary Health Care management.* The current centralised information systems are biased towards hospital care, and they are responding to the needs of PHC only to a limited extent. However, in order to provide PHC management with information appropriate for decision making, new kinds of locally based information systems must be implemented. Such systems will be based on a 'bottom-up' approach to the use of information. The deeply rooted curative bias inherent in the health system and HIS obstructs reform based on a preventive philosophy.

3 *Systems development.* The development of information systems focused on local decision making must be coordinated with a process of organisational change. The attitudes towards the use of information in health management as well as the managerial structures must be changed. This requires an evolutionary and participatory approach to system development - a process of continuous learning in order to modify and

improve both the information systems and the managerial systems.

A comparison with the situation in South Africa shows that:

1 In South Africa the old centralised structure is an important obstacle to decentralisation. An additional problem in South Africa is an extremely fragmented health care system reflecting the historical development of health services from colonial times, and the effects of apartheid ideology that organised both the health services and the society as such according to race.

2 The curative bias of the present health system in South Africa is as strong as in Mongolia. Nevertheless, a strong PHC movement and awareness may be important in counteracting this.

3 In South Africa, community participation in the development of health services is included among the issues that are given the highest priority in the African National Congress' (ANC) 'National Health Plan' (ANC, 1994a) and the 'Reconstruction and Development Program' (RDP) (ANC, 1994b). These important documents are guiding the official policies of the new Government of National Unity. The RDP has a title which clearly express its intent: the reconstruction and development of communities which have suffered under apartheid. The strong emphasis on community participation in South Africa, as opposed to the situation in Mongolia where such issues are barely mentioned, makes it useful to extend the notion of participatory design of information systems to include community participation.

In the following section, decentralisation and Primary Health Care are discussed together with the notion of technology. In the section after, the case of Mongolia is presented. Problems facing PHC management, shortcomings of the present information system and experiences from efforts in decentralisation of the information systems are reviewed. Later the case of South Africa is presented and in the final section, lessons are identified and approaches to the development of HIS discussed.

2. Decentralisation, primary health care and technology

Many developing countries are in the midst of a process of decentralisation of their governmental structures. Decentralisation can be defined in general terms as the transfer of authority or dispersal of power in public planning, management and decision making from higher to lower levels of government. Since health care is only one of the functions of government and its organisation is strongly influenced by governmental structures the decentralisation of the health sector must be analyzed in a broader context (see Mills, et al., 1990, for a comprehensive study of health system decentralisation). The district health system model, advocated by the WHO, is proposed as the most effective way of organising health services and of delivering primary health care (Amonoo-Lartson, et al., 1984). Key issues are:

1 the decentralisation of authority to a local management team, who can make decisions and control resources in the provision of health care in a geographically coherent area, a district;

2 sectoral and intersectoral co-operation; and

3 community participation in the services.

In the district system model appropriate health information systems play a crucial role in supporting local management (Wilson, et al., 1987).

In Mongolia, both the economic and administrative sectors are in the midst of a process of decentralisation. Former state-owned enterprises are being split up and privatised and governmental functions are being decentralised. In health care this process of change has resulted in a major shift in policy including decentralisation of health management, and a shift of focus from curative to preventive health care. Within a few years the Mongolian policy and ideology in general have shifted from the former 'think big and specialised' to the present 'think small and generalised'. The former one-sided focus on a Taylorised, hospital-based health care delivery, with a high degree of specialisation, is now being replaced by a stronger focus on 'the old family doctor' and a PHC approach.

South Africa has one of the least equitable health care systems in the world. It is a system that has served very well the health needs of 20 per cent of the population and left the majority, mostly blacks, with very poor health status and health services. The health system is highly specialised and centralised. The ANC National Health Plan for South Africa states that the PHC approach will be the underlying philosophy for the restructuring of the health system. Crucial to this will be the strengthening of community services through the development of a district health system. South Africa differs in many respects from Mongolia but both countries are in the midst of a transition from a deeply rooted authoritarian system to a more vaguely defined democratic system. In both countries,

decentralisation of the health system and a shift of focus from curative to preventive health care, i.e. application of a PHC approach, are on the top of the agenda.

This transition from a curative based to a preventive based health system is not only a question of the changing of structures. In adapting a PHC approach, deeply rooted values and world views with regard to society, technology and health care will be challenged. The landmark Alma Ata 'Health for All by year 2000' conference (WHO, 1978) defined PHC as:

> *Essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost the country and community can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination. It forms an integral part both of the country's health system, of which it is the central function and main focus, and of the overall social and economic development of the community.*

PHC is a very broad concept and as an approach to health systems development it is the very antithesis of the centralised and specialised health system of the former Soviet Union, on which the Mongolian health system is modelled. Similarly in South Africa, the first country in the world to do heart transplantation, children are still dying of measles and diarrhoea. The contrasts between specialised and generalised, between centralised and decentralised, and between curative and preventive are characteristic in comparing the old and new policies.

Pacey (1983) draws a line between similar dichotomies regarding health care and society and the notion of technology. He claims that preventive medicine, together with maintenance and hygiene, challenge the usual focus of technology on problem-solving in that they are concerned with problem prevention. Prevention, maintenance, organisation and end-use are all invisible to those who identify technology with hardware. In this way curative biases towards medicine are analogous to 'technical-fix' biases towards technology.

In health care, a curative bias reflects a mechanical perspective on health, while on the other hand, a preventive bias reflects a holistic perspective. Similarly, a one sided focus on hardware reflects a mechanical 'technical-fix' perspective on technology while a holistic perspective sees technology as a social construction and emphasises its use.

I will develop this analogy further and draw a parallel between the dichotomies mentioned above regarding the notion of technology and two contrasting approaches in systems development. What I label here as a technical-fix kind of project, e.g. construction of a bridge, a digital telephone exchange, or a hospital, is usually developed according to traditional engineering methodology. Needs analysis is completed before drawing up the specifications according to which the system is implemented. However, challenges in preventive medicine cannot be met by a technical-fix approach. The health system must be developed in a holistic approach integrating the development of organisations, technology and human capability. What is required is an evolutionary approach to systems development that encourages ongoing broad participation and mutual learning.

3. The case of Mongolia

During the summer and autumn of 1993, the author together with Ch. Nermunkh and G. Burendei from the Ministry of Health (MOH), Mongolia, carried out an investigation of health information systems in Mongolia. The main focus was on finding more efficient ways to use information in local decision making in order to support the decentralisation of the health services.

Mongolia is a large, landlocked and sparsely populated country in the northern part of Central Asia, located between Russia on the north and China on the east, south and west. The population of Mongolia is only 2.2 million. Although 52 per cent of the population lives in 3 industrial towns and 18 Aimak (province) centres, 28 per cent live mostly as semi-nomadic herders scattered in small groups of families. The 18 Aimaks are divided into 317 Soms, each having an administrative centre. Many changes have taken place in the political and socio-economic situation since 1990. The country, formerly a part of the Soviet block, has changed from a single party system to a multi-party system. The subsequent transition from a command economy towards a market economy has been marked by a severe economic crisis with shortages of food, medicines, fuel and everyday necessities as well as substantial unemployment.

3.1 Decentralisation and PHC

As part of the general decentralisation of power, functions and responsibility have been handed over from the Central Government to the Aimak administration. In building these new decentralised structures, the availability of and support given by appropriate information is of primary concern. So far, the HIS has failed to keep up with the changes. The systems are based on the needs of a centrally planned economy and a Soviet influenced health system with bias on hospitals and curative care. Formerly the health sector was evaluated and progress and fulfilment of the plans was measured according to the number of beds, hospitals, physicians, patients, diagnosed cases, etc. This is reflected in the two main characteristics of the existing systems:

1 the system is centralised and vertically organised, and
2 the data collected and the information provided are biased on hospitals and curative care.

The national health information system can be perceived as consisting of four different vertically organised systems all having their own information handling systems:

1 The main Health Statistical System produces the official health statistics;
2 The Infectious Diseases Control Centre is responsible for collecting data as well as producing statistics and information on infectious diseases and immunisation;
3 Pharmacy and drugs; and
4 Hygiene Control Centre where information about sanitation, hygiene and water-supply is collected and reported.

The verticality of the systems reinforces the problems of making use of the information locally as each of the different flows of information tends to by-pass the Aimak level. As originally intended surveys of the entire health information system are only possible at top level. These features of centralisation strongly contradict the needs of the decentralised administrative institutions which emphasise local decision making and, as a consequence, local information support. This implies that the four independent flows of information described above should be 'grasped' and integrated in an Aimak HIS. This process of decentralisation may be viewed as a democratisation of the information system since the responsibility for processing and use of the information will be given to the communities where the data is collected.

3.2 Information at Aimak level

The present HIS is designed for statistical purposes; local use of information is not encouraged and the feedback mechanisms are weak. No 'ownership' of the HIS is created among the health workers who collect the data (Nurminen, 1988). They do not regard the HIS as something they can change according to their own needs. Due to this lack of local use of information and local involvement the problems in the communities are rarely addressed by the HIS. Local use and processing of information is a key issue in order to improve quality of information at both local and central level. By quality I understand both accuracy, i.e. the data are correct, and relevance, i.e. (right) answers are given to appropriate questions. I will illustrate this by an example from Bayanhongor Aimak. This Aimak covers a vast area and contains two different mountain ranges and a part of Gobi dessert.

The statistics from Bayanhongor shows that the infant mortality rate (IMR) in the Aimak is decreasing and that the level is not high as compared with other Aimaks. This is true but this average hides the real situation: The IMR in the Soms vary between 0 per cent and 27 per cent. Particularly in the mountainous region, the IMR is high and increasing. When visiting local hospitals in this Aimak, we learned that the majority of infant deaths took place at home, a fact that is not reflected in the statistics. The official statistics simply give the number of deaths with no analysis of the causes of death. In Erdenetsogt, a small town in the mountainous region, we were told that only one out of 17 infant deaths (19 per cent IMR) by early September had occurred at the hospital! Therefore the hospital could not be blamed for the high infant mortality rate. Both the number of deaths occurring at home and the infant mortality rate had increased in comparison with the previous year. The problem, we were told, was the shortage of petrol and the corresponding poor ambulance service.

Shargalzuut is a nearby small-town with a hospital in the same mountainous region. Here too, both the infant mortality and the number of infant deaths occurring at home were increasing. In Shargalzuut they explained the similar situation differently from what they did in Erdenetsog. The problems, they explained here, were due to the socio-economic changes: privatisation of livestock which have caused the herders to take less care of the children. Parents work out in the fields while elder children take care of younger children. Also the herders have

moved farther away from the hospital located in the centre.

In Erdenetsogt, the number of children attending school were decreasing. Contrary to the explanation regarding infant mortality, this problem was explained by the privatisation of livestock. They planned to counteract it by moving teachers out to the small settlements. According to a PHC approach, they might have acted in a similar way to counteract the high and increasing infant mortality, i.e. moving the health care delivery out to the small communities. With this example I want to illustrate that the 'curative bias' is deeply rooted in both the structure of health care and in the health workers themselves. The workers' attitude is that when they are working in a hospital and the infants are dead on arrival, there is not much that they can do. To address this problem, the structure of health care delivery and the staff's assumption of responsibility and their way of thinking need to be transformed from a curative to a preventive bias.

In this example, the HIS was not used to analyze the infant mortality, the most important health problem in the area. How could an information system respond better to the needs of PHC? According to Ties Boerma (1991) the following features of PHC are particularly important with respect to health information:

1 Equity in health is the underlying rationale for all health information efforts.
2 Preventive care. More emphasis has to be put on attempts to know what is happening in the communities as opposed to health care facilities.
3 Community participation is the key feature of PHC. Communities should participate actively in the health-information component of PHC-programmes.

Equity in health means that the most needy groups and individuals must be identified and strategies should be designed to redress inequalities. In the example above, the mothers and infants in the herder families should be focused on and the infant mortality should be analyzed. The HIS should make it possible to monitor and evaluate achievements in PHC programmes addressing these problems.

Preventive care focuses on what happens outside hospitals through inclusion of community surveys and community generated information. Hospital based data is not sufficient in this regard. As our example shows, the infants are dead on arrival at the hospital. As no children die from a lack of petrol (as a primary cause), the causes must be sought elsewhere, i.e. preventive action in the communities.

Community participation: information should address the health needs of the communities. In our example the infants of the herder families and remote households have a much higher mortality than others and should therefore require special attention. The community should participate in collecting and analyzing the data to ensure that the right targets are being set. Indicators on how the targets are being met should then be presented to the community to ensure community participation. Appropriate ways of presenting information using wall graphs, etc. must be explored.

Development of a HIS that respond to the needs of PHC is only possible if carried out as part of a general 'PHC-movement'. The present HIS reflects the present health system. Thus, the development of a HIS to support PHC must be integrated with the development of the health systems in general towards a PHC-approach. The limited focus on preventive care in Erdenetsog was not due to lack of information; it was due to the very thinking about health care. To develop the health system towards preventive care all health workers must be engaged and committed to changes.

3.3 Computer use and information for PHC-management

During spring 1993, all Aimaks were provided with microcomputers. As a first step, the main statistical software used at central level was distributed to the Aimaks. The plan is to 'force' all Aimaks to deliver the routinely collected data on discs. In this way the data 'must' be typed into the computer and, as a consequence, local processing of data will be possible.

The Aimak hospital in Bayanhongor and three other Aimak hospitals had already purchased their own computers when MOH provided all Aimaks with computers. In early 1994, these four Aimaks were the only ones using the microcomputers according to the plan, i.e. to produce reports for the MOH and to deliver the reports on discs. At that time none of the Aimaks used the microcomputers to analyze data according to their own needs. This indicates that the introduction of microcomputers in a top down fashion is a problematic task.

The statistical software distributed to all Aimaks is used in Bayanhongor to produce monthly statistics. The problem is that these are based on central requirements and do not address local needs. The case described above

illustrates this issue. The causes of infant mortality, its distribution, and whether or not it occurs outside hospitals are not analyzed. No indicators are calculated to evaluate the performance of health services in counteracting the infant mortality. In short, the HIS is not used as a tool in local health management.

The suboptimal use of the computer in health management of the Aimak is mainly due to the organisational situation. The local government health management is responsible for health information in the Aimak but they do not 'control' the microcomputer, as this is located in the Aimak hospital. In the hospital, on the other hand, they control the computer but have no ownership in the HIS. They enter the data collected by health workers in the Soms and in their own hospital into the computer and produce the reports to be handed over to the Aimak health management. Neither the health workers who actually collect the data nor the staff dealing with the computer have any interests in the performance of the HIS. It is now planned to make the statistical office in the hospital responsible for health information in the Aimak.

In Bayanhongor, data on each death are now being entered into the computer and reports are sent on discs to MOH. Although analyses based on non-aggregated data are possible to perform, this is so far not done in a systematic way. This is not because the staff at the hospital are unfamiliar with the computer. The reason is, as pointed out above, that the staff who actually work with the computer and thus deal with the HIS have no responsibility or interests in making the HIS respond to problems and needs in health management. On the other hand, they have on their own developed several small applications responding to their needs, i.e. the needs of the hospital. These are spreadsheet and database applications handling hospital budgeting, staff register, salaries and hospital productivity. In addition, several reports are being produced when needed by the hospital management. The successful use of the microcomputer in the hospital is mainly due to the enthusiasm of the manager of the hospital. He took the initiative to purchase the computer, and he was the first one to learn how to use it. This example illustrates the importance of basing development of decentralised HISs on local initiatives and interests, and the importance of addressing the empowering of the local users and the creation of local 'ownership' to the system. Also, this case confirms Walsham's advice to developing countries to move towards Type B ('bottom-up') approaches to decentralised information systems, since Type A ('top-down') approaches are unlikely to be successful (Walsham, 1992).

4. The situation in South Africa

The population of South Africa is about 40.7 million and about 48 per cent of the population is estimated to live in urban areas. The latter figure is increasing as South Africa is experiencing rapid urbanisation. This follows the abolishment of legislation used by the apartheid state to keep blacks out of urban areas. Influx control, pass control and forced resettlement were among the means used by the apartheid state to obtain this. After the April 1994 election, a new Government of National unity has taken over. In the reconstruction of the health services in South Africa, the National Health Plan (NHP) and the RDP give the following tasks top priority:

1 to draw all the different role players and services into a unified National Health System (NHS) under a single Ministry of Health;
2 to use the PHC approach and to focus on community participation; and
3 to create health districts that will be responsible for PHC in a decentralised NHS.

To support this development and to make rational planning possible, both the NHP and the RDP state that an effective National Health Information System (NHIS) must be introduced. The NHIS is an umbrella concept which encompasses a number of different sub-systems.

A process towards developing a NHIS was initiated by a seminar in Broederstroom in March 1994. Here consensus on a national policy for setting up a NHIS was reached and task groups were formed to elaborate the policy further. After the election this process was carried on by a national committee established by the department of health for the setting up of a NHIS in South Africa. Working groups have been created in all provinces and workshops are being held. The aim is to analyze the situation in each province and to make plans for the development of the new NHIS in the provinces. Also the provincial plans for the development of HIS are to address the specific RDP health priorities (put forward by the Ministry of Health) and to monitor their implementation.

In this section, I will give a brief account of the fragmentation of the health services in South Africa and some of its historical background. I will also comment on possible strategies for developing HISs. My background in doing so is that I attended the Broederstroom seminar and for the last four months of 1994 I worked in the task

group for the regional HIS in Western Cape Province. As an outsider I had a hard time struggling to understand the apparently chaotic organisation of the health care system in South Africa and the 'spaghetti-like' way different health systems and HISs are interacting.

4.1 The fragmentation of the health services in South Africa - an overview

The health system is extremely fragmented. It is fragmented vertically by race and horizontally by type of service, i.e. between preventive and curative health care and specialised services such as tuberculosis and psychiatry. There is geographical fragmentation in that each homeland and each province in South Africa had its own separate development, and there is a rural/urban fragmentation in the health services. Typically, in one geographical area there will be multiple authorities providing health services with little or no co-ordination. This system reflects both the historical development of health services from colonial times and the effect of the apartheid ideology. Until May 1994 there were fourteen departments of health at central level: the 'general' Department of National Health and Population Development, three for the apartheid specific 'white', 'asian', and 'coloured' administrations and ten for the 'black' 'homelands'. Outside the 'homelands' public hospital services are provided by the provincial administrations. At the local level, more than 400 local authorities and regional service councils of different types are responsible for PHC and public health services. The private health care sector provides curative services to less than 20 per cent of the population yet consumes 61 per cent of the total national expenditure on health.

At the local area level, the level where the PHC policy will be implemented and where equity in health is to be ensured, the fragmentation can be said to occur on two levels: the local government level and the health service level. The problem is that these two levels have no accountability to each other and neither do they have any accountability to the community. The district health system to be implemented is intended to solve this mess. Some examples from Cape Town will help clarify matters.

4.2 Fragmentation - examples from the Cape Town area

In the Cape Town area, there are four different health systems and thus four different health information systems. The fragmentation is due both to the different services the systems provide and the different populations they serve. The health department of Cape Town City Council, 'City Health', is an old institution responsible for the non-hospital health services in the urban areas in and around Cape Town, traditionally the white areas. Already in 1923 the Native Urban Areas Act restricted the movement of Africans in urban areas by means of influx control and the setting aside of areas for housing for Africans. Under apartheid, using the Group Areas Act (1950), the government embarked on a program of ethnic spatial engineering. Shanty towns and inner-city slums were demolished, and huge townships were constructed at distances from white areas.

Some 20 years ago 'Regional Service Council' (RSC) started to deliver non-hospital health services to the so called peri-urban and rural areas around Cape Town not covered by City Health. As a legacy of apartheid the City Health Department covers all the white areas and only some of the black areas, while RSC mainly covers the black areas. Each of these two health organisations run their own comprehensive computer-based information system, based mainly on data gathered from the day hospitals and clinics that they run.

The Provincial Administration of Western Cape (PAWC) is responsible for hospital services and some PHC clinics and thus forms a third health system. Their information system is based on hospital data routinely collected in all (public) hospitals in the province and from some PHC clinics that they run themselves. The provincial office of Department of National Health (NH) runs the fourth HIS in the area. It collects geographically comprehensive data from the hospitals, clinics of 46 magisterial districts (MD) and 64 local authorities (LA).

The MDs cover the entire area of the province but have no governmental authority. They are areas of jurisdiction containing a police station. The LAs, on the other hand, have some governmental authority in their municipalities and run clinics, schools, build roads, etc. The LA-municipalities (mostly white) are widely dispersed and surrounded by rural and peri-urban areas. The areas not covered by the municipalities have no local autonomy and are run directly by the RSCs. A typical situation was that farm workers living just outside the municipality had no right to access the clinics run by the LA. As a late development, the RSCs set up clinics for the farm workers thus exposing and aggravating the fragmentation along race lines. Also the PAWC could run a clinic in the vicinity, adding to the organisational fragmentation. According to the health information officer in PAWC, in one particular street in Cape Town there are three clinics run by PAWC, RSC and the municipality respectively which report to

three different HISs. Such fragmentation is an important obstacle to providing information for PHC management who require a coherent overview of the distribution of clinics, their catchment populations, workloads, etc.

A study of the HISs in the Western Cape, carried out by the above mentioned task group, shows there is no integration of information from the different services; there are no common goals, no standards for reporting and different target populations are used, so that there is no comparability. There is duplication so that the same pieces of data are collected many times for different purposes. Yet at the same time there are enormous gaps and much data is irrelevant to both collectors and managers. The volume of data collected is enormous but the quantity of useful information produced from it is minimal. Much time is spent collecting data but there is in general no local use of the data. The HISs reflect the centralised and vertical structures of the health services and the top down command structures that hardly involve service providers in data analysis or decision making. Because the HISs do not address local needs and do not engage staff at local level in data analysis, a vicious cycle reinforces centralisation and fragmentation.

4.3 Restructuring the health system and developing the HIS

The NH and the PAWC are to be merged by the end of 1994. City Health and RSC will also be merged and reorganised when the new health district are to be implemented. This implies the merging of a national institution with a provincial one. Differences in culture, management structures, etc. are substantial, as are the differences in salaries and working conditions. The process of bringing the national and provincial structures together has been more complicated than foreseen. It is expected to take 3-4 years to establish the health districts. Important in these merging of organisations is the integration of their information systems. The four information systems are all centralised, as are the organisations they serve. Integration of the ISs (co-ordination of input, output and routines) should go hand in hand with, and even support, the process of integrating the organisations.

The integration at local level will require the establishing of new managerial structures responsible for PHC in the communities. I will give an example to illustrate this:

Atlantis is an industrial town with a population of 60-70,000 people situated 50 kilometres from Cape Town. As a consequence of the Group Areas Act, the town was created in 1975 as an effort to stop the influx of 'coloureds' into Cape Town. Subsidies were given to encourage the establishing of factories. After the subsidies were brought to an end a lot of factories closed down and the unemployment rate rose above 50 per cent. In the area covering Atlantis, a village and the surrounding farmland, there was one hospital, three clinics and a number of NGOs and private practitioners. Of the three clinics, two are under RSC and one is under PAWC, as is the hospital. There is no co-ordination of information and the clinics and the hospital send their reports to three different places. The private practitioners and the NGOs dealing with health care delivery do not report anywhere.

A project has been set up by the Department of Community Health, University of Cape Town, to investigate the use of health information and the routines for collecting data in Atlantis. The project has analyzed the information flow from the different health facilities. Because the system of data collecting is not objective-driven and is so fragmented the project reports that the information derived is not very suitable for local management. For example, there is no profile of patients or diseases in the area, and there is no data on effectiveness and efficiency of the health services. As the existing systems of data collecting are established to respond to central requirements and not to address needs of local decision making this is understandable. There is no co-ordination of the health services in Atlantis. Thus, no authority is yet in place that could actually use the needed information in decision making.

According to plans, the project mentioned will start developing a local HIS in Atlantis in 1995. This must relate closely to the development of new managerial structures in Atlantis unifying the different health services. It might be useful to look at the development of the HIS as a tool to support this process. Support of local decision making development of the district HIS will entail identification of needs, objectives, priorities and the range of decisions to be taken. In this way the process will focus on management performance and structures, and the further development of these, as much as the information system itself. The quality of the information system will be ensured by linking the HIS to management decision making. In this way the new managerial structures will be developed together with new managerial tools provided by the HIS.

4.4 NHIS and the RDP

The Ministry of Health has compiled a list of 26 RDP health priorities and has stated that a main target for the NHIS to be developed is to support these. The priorities are of various kinds, ranging from health programs like 'provide free access to health services to children under 6 years', to health system restructuring; 'establish health districts' and to the promotion of community participation. These various health priorities relate to IT in different ways, making it necessary to distinguish between different ways in which the HIS may support the priorities:

1 Health programs. Monitoring of certain programs through focused collection of data and calculating of indicators is a priority, e.g. mother and child health, mental health, infectious diseases, AIDS, etc. will be closely monitored.

2 Health system restructuring. The NHIS should be used as a tool in the process of restructuring the health system and creating a united (non-fragmented) NHS and supporting the new district structures. In this way the managerial tools of the HIS will be developed together with the new managerial structures of which they will be an integral part.

3 Community participation. Involvement of communities in the planning, managing, monitoring and evaluation of health services is a crucial issue of the PHC approach and a major priority. The community will need appropriate information in order to determine their health needs and to monitor and evaluate the health services. The NHIS should facilitate community participation by providing regular, useful feedback on the achievements and constraints of the health services. The information must be provided in appropriate ways, e.g. using graphs, maps and, in order to reach greater parts of the community, other techniques that could be used by the mass media. In an effort to institutionalise community participation, the RDP prescribes the setting up of inter-sectoral Community Development Committees and Community Health Committees, both to be elected from the community. The HIS should facilitate the interaction between these committees and the health services. This make it necessary to involve people from these committees as active participants in designing and developing the HIS at the district and community level. Thus, the HIS must address the needs of the community, not only the needs of the health services.

4.5 Obstacles to community based development

While having the best technical and medical resources and the best developed infrastructure in Africa, South Africa has not demonstrated any ability to use its wealth for the benefit for the majority of its own population as is evidenced by a very weak PHC structure. Only a very small part of the total health expenditures is used for PHC. The local authorities which are responsible for promotive and preventive services account for approximately 4 per cent of total public sector health expenditure. Central departments dictate what information should be collected and there is very little use and analysis of data at local level. PHC at community level and higher levels is not co-analyzed and it is unevenly distributed between and within communities. The centralisation of health services, the high-technology, the curative bias and the fixation on western models of health service delivery, all constitute powerful forces against the implementation of the new PHC based policy. 'Technical-fix' biases towards technology and health and the 'top-down thinking' reflected by such biases are significant obstacles to the 'bottom-up' approaches to development that are required to address community participation and the implementation of a PHC policy.

5. Discussion of the two cases

5.1 Comparing the two cases

While being as different from each other as countries can be, South Africa and Mongolia still share some features in their strive to reconstruct their health systems. The health system in both countries, as a legacy of the past, still reflects the ideology and economic structure of the former Soviet Union and the apartheid state respectively.

In Mongolia the extensive distribution of health care facilities in all communities all over the country reflects the ideological focus on equity - and the need of the state to control all aspects of society. Their system of referral of patients over great distances to specialised hospitals was based on the curative and 'technical-fix' biases of the former Soviet Union. After the break down of Soviet Union Mongolia discovered itself to be among the poorest countries in the world. The health system relied upon the availability of free transport (petrol) and medical

equipment, drugs, etc. provided by the Soviet Union. The system was much too expensive to be viable.

In South Africa the resources of a huge country were channelled to support a minority with one of the best hospital-based health systems of the world leaving the majority with very poor health services. Today when equity in health is required it is clear that the South African health system is also not financially viable - it would be impossibly expensive to expand the comprehensive hospital based system to serve the entire population.

Thus from very different points of departures and with very different legacies of the past, both Mongolia and South Africa have embarked on the development of a viable health system based on a PHC approach. Mongolia has its advantages in that the structure, the health districts (Aimaks) and a network of staffed health facilities are in place. But the PHC awareness is still to be developed. South Africa on the other hand has not yet developed the structure but has an advantage in the well established PHC movement.

The main lesson from Mongolia is that the development of new HISs must be integrated with the development of new managerial structures. In Mongolia computers and software were simply distributed to the Aimaks. No effort was made to develop ways to make use of information in local decision making or to establish a management authority that could make efficient use of the information. The training provided was directed towards the use of computers and software. How information could actually be used in order to strengthen health management was not addressed. As a consequence the introduction of computers at Aimak level have so far not caused substantial changes towards better use of information in decision making. The centralised and vertical structure of the old system and the inherent curative bias both constitute important obstacles to change.

With the extremely fragmented health services in South Africa and their highly centralised structure it is to be expected that the structural resistance to change might be as hard as that experienced in Mongolia. Therefore the need to integrate the development of the NHIS closely with the development of new managerial structures and the strengthening of PHC management might be as important in South Africa as it has proven to be in Mongolia. Also, the curative bias of the present health system in South Africa is as strong as it is in Mongolia. The hospitals consume the substantial part of the public health expenditure and a redistribution of resources from hospitals towards PHC will certainly cause problems.

5.2 Bottom-up development

A decentralised and democratic biased 'bottom-up' approach to health systems and HIS will require local initiatives and enthusiasm. This again emphasises the necessity of empowering communities and allowing communities to participate in developing the health systems as envisaged by the RDP.

In one of the examples from Mongolia the health workers in a hospital complained that the infants were dead on arrival at the hospital. Consequently they found it difficult to take action. This illustrates that the local health workers are not (at present) taking part in a community based 'PHC-movement' and the 'PHC-awareness' in the communities is limited. In the example, the local health workers and health management neither used the HIS as a tool in detecting problems and setting targets nor did they use the HIS to calculate indicators to evaluate how targets were met. The IMR was extremely high but they did not analyze the information available in order to take appropriate action. The most important piece of information in this regard, the fact that nearly all of the infants deaths occurred at home, was not even reported. The central requirements on data collection did not ask for it. In order to change this tendency it will be important to create a sense of 'ownership' and to empower the end-users; the health workers who collect the information must feel that it is useful and they must start to use the information in their work. The example from the hospital in Bayanhongor, Mongolia, shows that such ownership is possible to create.

In South Africa the situation regarding 'PHC-awareness' is different from Mongolia. The restructuring of the health system and the PHC approach is a central issue in the political movement that has swept away the former apartheid system. As engagement and awareness are prerequisites for community participation this may be more easily achieved in South Africa than in Mongolia. But the 'information awareness' among health workers and health management seems to be as limited in South Africa as in Mongolia.

A shift of focus from curative to preventive care implies that other kinds and sources of information are needed. Focusing primarily on local information, and possibly local action and decision making, is, according to Opit (1987), a central requirement for getting the right information and making appropriate use of it. The local community is where the information missing from the hospital based system is available; such as information about

who is not receiving care and about social cultural and political constraints on desirable health service action. As indicated in the example from Mongolia local use of information is also a strategy to ensure the quality of the information.

5.3 Community participation and participatory design

It is difficult to distinguish between the development of health systems and the development of the corresponding HISs. The examples from Mongolia have shown that problems with regards to information systems can be traced back to causes in the organisational context and in the nature of structures, power and values in society. In South Africa the HISs are a reflection of the fragmented health services. Thus the development of HIS must be understood as an integral part of the reconstruction of the Health System. In South Africa, community participation is seen as a central issue in building the new health system. Also community participation is a central feature in the PHC concept on which the new health systems both in South Africa and Mongolia are to be built upon. As argued in a previous section, community participation is a key feature in a HIS addressing needs of PHC.

The emphasis on community participation makes it necessary to develop further the notion of participatory design (PD) approaches to system development which addresses the participation from the (future) users of the IS (Floyd, et al., 1989; Greenbaum and Kyng, 1991; see also special issues of Communication of the ACM June/1993 and January/1994). The development of a PHC based health system that takes account of community needs should be closely linked with the development of the HIS. As the users of the PHC based health system will be the members of the community, they must be able to participate in its development. The HIS should be used in the communication between the health services and the community thus facilitating community participation. In this way HISs may play a key role in carrying out the community participation policy. In this approach the HIS should provide information on the main health problems of the community in a way that makes it easy to involve the community in setting targets for improvements. In the next step the HIS should present indicators to involve the community in both meeting the targets and in evaluating the performance of the health services in this regard.

Thus the users we must address are the users of the health services, i.e. members of the communities and not only the users of the IS in the organisation(s) in question. In this I agree with Korpela (1994) when he claims that the clients of IS users should also be taken into account in order to avoid the risk of developing 'user friendly mafia systems'. In our context, the aim should be to ensure that the health system responds to the needs of the communities.

Miller (1992) argues that the way systems are created shapes both the systems and the environment within which it operates. Thus when the objective is to develop a system to enhance community participation a PD approach should then be appropriate. The process of system development could then serve as a training field for community participation. As argued in an earlier section, the very nature of PHC and preventive action makes it important to use evolutionary and participatory approaches in the development of systems based on such concepts. Miller argues further that a PD approach has a chance to influence events if it manages to attach itself to and draw energy, legitimacy and support from a larger movement. The PHC movement in South Africa has potential in this regard.

Greenbaum (1993) put forward three perspectives for the need for PD approaches:

1 a pragmatic perspective, a functional way to increase productivity;
2 a theoretical perspective, a strategy to overcome the problem of lack of shared understanding between developers and users; and
3 a political perspective, a democratic strategy to give people the means to influence their own work place.

In accordance with the discussion above, I will put forward a fourth perspective on PD approaches; a strategy to enhance community participation. This perspective is derived from the democratic perspective above but extended to encompass both the workplace and the community. Members of the community are users of the health services. A PD approach including these users as participants focuses on the end-use of the technological systems to be developed, i.e. the community based PHC services. As pointed out in an earlier section, broad participation will be necessary in order to develop systems and technology based on the principles of PHC and preventive action. A PD approach aims at helping the community to formulate their needs and requirements for health services and uses the information system as a tool in this regard.

6. Conclusion

I have outlined two broad areas of obstacles to change in the health systems of Mongolia and South Africa:

1 For decentralisation the important obstacles are the vertical, fragmented and centralised structures.

2 For instituting a PHC approach the important obstacles are the hospital based structures and the curative ideology.

As argued above, within both areas IT has the potential to contribute to the process of change. Decentralisation will require the development of HIS appropriate to each level of government and management. Important in this regard will be to develop the HIS integrally with the development of the new managerial structures at district (or Aimak) level. In order to support PHC the HIS must address both the needs of PHC management and the needs of the community. As argued above participatory approaches to systems development might be important both in defining the needs and in making the HIS address these needs. An important issue in PHC management is to use information in decision making. So far this is not part of the PHC management culture and it will be important to integrate training in use of information in the process of developing the HIS. Therefore the process of system development will not only address the development of new managerial structures and a new HIS; ways of using information in decision making must also be addressed. Integrating these three issues will require an evolutionary approach to system development and the desire in each participant to learn continuously from his or her experience.

My aim in this paper has been to link the concept of community participation (inherent in the PHC approach) with the concepts of participatory design from the discipline of systems development. I have argued that the concepts of participatory design should be extended to include community participation in the development of health information systems to support PHC management. This would simultaneously facilitate community participation in the implementation of a PHC approach.

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Building a system within its context: A case-study of Petróleos Mexicanos

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Abstract
The need to build adequate information systems has been widely emphasised in the literature on information systems in developing countries. To achieve this goal one must consider the cultural and political context in which a system is to be developed, in order to obtain the benefits that information technology can offer. The existing methodologies for developing systems, even those that consider participative approaches, do not address the limits that a specific reality poses to the development of systems and the ways to solve them. This article looks at the development of an institutional database for planning and evaluation at Petróleos Mexicanos (Pemex), a state-owned oil company in México. Pemex has a strong organisational culture based on the control of information as the source of power, with which its basic flows of information have been disconnected. Formal information systems have been directed to daily operation. Building the database with reliable information has been a big task in terms of information systems management. This case provides a good example of how to develop and implement an adequate system within its own environment.

1. Introduction

This paper is a case study of the development of an information system at Petróleos Mexicanos (Pemex), a Mexican state-owned oil company. Pemex, as a public enterprise, has a very peculiar character in its type of management and in the way the operations are carried out. The company has been run upon the rationale dictated by government politics. The conditions upon which the company operated changed dramatically with the international oil crisis at the end of the 80's. The new circumstances urged for a tighter control of the operations. But the exercise of evaluating performance required formal information. Pemex had been run basically through informal flows of information. The power structure of the organisation was a type of a 'conglomerate of feuds'. The source of power of each enclosure was its control over the information of its operations. Within this context, building a corporate database to monitor the performance of the company was a true challenge.

2. Historical background

In 1901, the first oil law that gave the right to the federal government to give concessions for exploring and extracting oil on land belonging to the nation to foreign companies established in the country was introduced. By 1935 they were 17 foreign oil companies operating in the country. The workers of the different oil companies tried several times - with the companies' disapproval - to organise themselves. In 1935 the workers finally succeeded in establishing the Union of Oil workers of the Mexican Republic and proposed a collective contract. The oil companies accepted a large part of the contract, apart from the terms outlined for the workers' fringes benefits. The oil companies argued that they could not cope with the economic demands of oil workers. The government tried many times to find a negotiated solution but the oil companies refused to compromise.

The conflict ended at the Supreme Court, whose decision was in favour of the Union's demands. Even then the foreign companies refused to comply. On March 18, 1938, President General Lázaro Cárdenas issued the law of expropriation of the foreign oil companies operating in México and created Petróleos Mexicanos. Pemex was founded as a public institution to manage the assets of the companies that were nationalised. It was entitled to perform all operations related to the oil industry. In those days, the mission of the state-company was to satisfy the internal demand of oil and refined products in order to prevent the collapse of the economy. The Administration

Board, whose six members have to be appointed by the President of the Republic and three by the Union, has been the highest authority of the public corporation. The appointment of the Director of Pemex has always been political.

The day after the expropriations, the Union started the process of homogenising the different administrative procedures used by the foreign companies. At that time there were around 13,000 employees in the 17 foreign oil companies. The oil production level decreased in the first few months after the expropriation. The company reduced its oil exports, and until the mid-70's the company's production was directed mainly to the internal market.

During the history of México, the energy policy has always been dependant on the economic policy of the government. This feature was enforced by the nationalisation of the industry. In México the public administration changes hands every six years and with it the appointment of the CEO of the company. Pemex has been influenced by these periodical political movements that are reflected in its organisational culture.

3. Organisational culture

The culture of the organisation, 'the way we do things around here', gives identity to a company. An organisation is a dynamic entity and so is its culture. Authors such as Warner (1989) also distinguish between climate and culture, the latter being the features of the organisation with major permanence that only change due to major internal or external changes. For some companies the founder becomes the key determinant of the character of its organisational culture (Schein, 1992). In the case of Pemex the personality of its first Director did not determine the characteristics of its culture, but rather the events around the law of expropriation that gave birth to the company. From the origin's of Pemex it is possible to trace the features of its culture and follow the way they have evolved.

The fact that Pemex is a stated-owned company provides the general context in which it operates because all its activities are regulated by the central government. The mission of the company has been centred in its *raison d'être*: producing the oil the Mexican economy required. The events that arose after the expropriation provided the new organisation with a very strong character of cohesion. The foreign companies organised a campaign to discredit the new enterprise as a group of burglars with no technical knowledge (Sampson, 1988). This statement had some truth in it because all the engineers that worked for the oil companies were foreigners who left right after the expropriation.

The Mexican workers had to continue the operation of the oil wells and distribution centres. They had no managerial experience. The whole process of taking over the responsibility was carried with a very profound feeling of patriotism and dignity by the employees. The workers lived the process with a sense of deep pride, proving to the world that Mexicans were able to carry on producing and distributing oil in an organised way. The mission of the company was achieved with no space for considerations of efficiency or rationality of its operations. This fact became embedded in the culture of Pemex which ended as a bureaucratic organisation with a strong reputation of red tape and inefficiency.

Organisations are dynamic systems they change by external and internal influences (Schermerhorn, 1985). Pemex being a state-owned oil company has been dependent on the country's political flows and the conditions of the international oil market. Public organisations work with a type of dis-functionality (Avgerou, 1990) because they do not follow the rationality of the operations of private companies. For the market rationality the ultimate goal is profit, and so financial considerations are the key factors that determine the way operations are carried out. In the case of Pemex the dis-functionality affects it in various ways, like periodical turnover of white collar managerial staff, lack of transparency in the operations of the company, absence of articulation between operations and administrative functions, and predominance of informal flows of information among the operational and administrative areas.

Organisations are considered political and pluralistic systems in which the interests of the various groups that form it do not necessarily match each other (Angell & Smithson, 1991; Kanter, 1992). In the case of Pemex two organisational cultures can be identified that are more than just different groups with conflicting interests:

1 The oilmen, workers and employees that stay on - regardless of the political changes of the central government and the administration of the company -and whose jobs are linked to operations.

2 The group of executives that come into office with every change of public administration to stay in the company for a period of around six years, whose jobs are managerial.

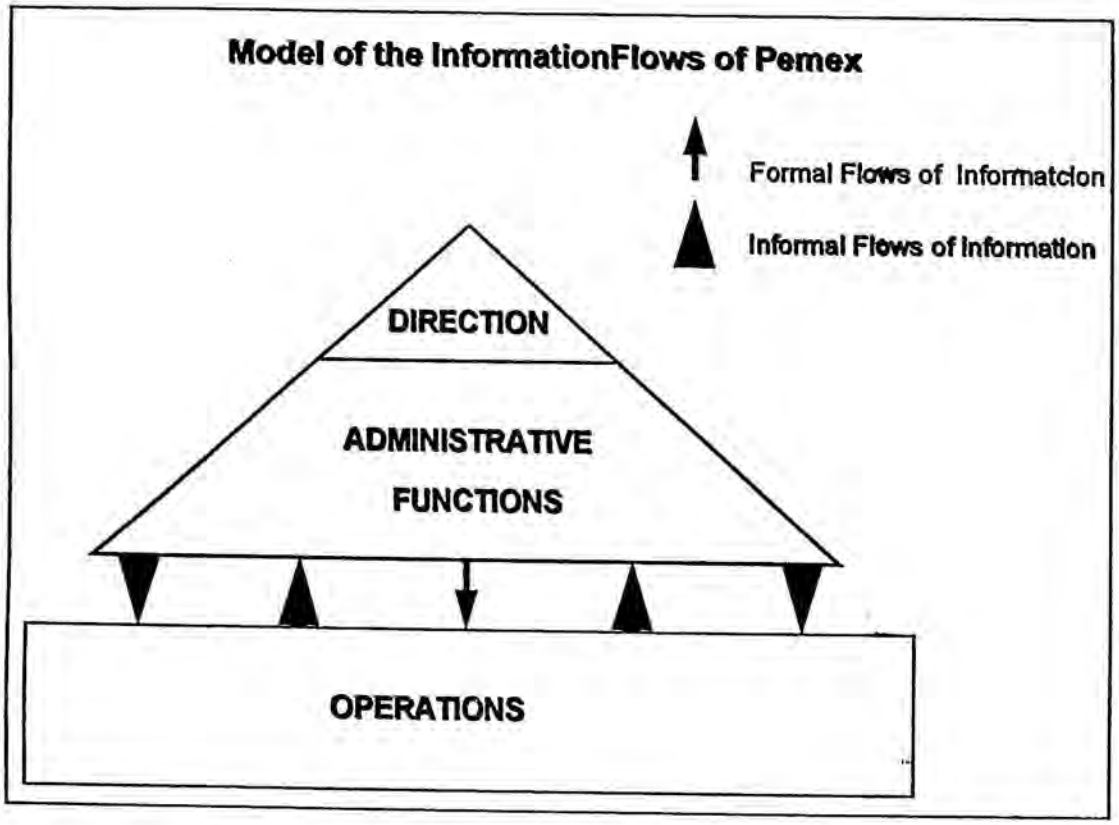

Figure 1: Information flow within Pemex

The culture of the oilmen can be identified with the origins of the company, regarding the goals of producing oil to keep the Mexican economy going. The culture of the 'temporary' managerial group is determined by the political line of the Public Administration in post. The oilmen, employees and workers have been the permanent population that have operated the technical functions necessary to produce oil. They basically have had permanence in the company regardless of the changes occurring in the political sphere of the country. The other culture has been of the passing group. The CEO is appointed by the President of México and is therefore a political post. Every six years, the new CEO appointed brings in his new work team to the high managerial levels of the company. These people know that they will only be in their posts for the duration of the presidential period.

In every process of change of administration the 'syndrome of the conquest' is repeated. The new group in power 'identifies everything that comes from the past as evil, and builds its church on top of the pyramids'. The values enforced are those of the new political administration. The 'new gods' have an intolerance to past practices and values.

Until the administration of President Miguel de la Madrid, beginning of the 80's, the two cultures were able to coexist more or less at ease. The problems and conflicts that arose were basically related to the relationship with the Union. The mission of both groups was at the end the same - producing oil; they did not have key conflicting values. Every new administration has its own values and flair of management. In theory the new managers come into the company to increase profitability. In reality their work is determined from a political perspective. They have to comply to the political line of the central government to maximise their personal 'political capital'.

The oilers at higher hierarchical levels operate like 'feuds', their legitimacy arises from their technical and proven competence. Even technical professionals become vulnerable to the influence of the political dictum when they are handed over high managerial responsibilities. To avoid conflict and keep their posts, they have to comply to the political line of the group in power. The oilmen had for many years enjoyed job security. The new administration that came into office in 1988, challenged 'sacred values' of the industry as the myth of job security for oil workers. By early 90's, half of the employees of the company had been made redundant.

The political power of the Union is another aspect of the oilmen's culture that comes back from the expropriation days. The workers made Pemex their company. The Union was extremely powerful, it could have even disrupted the operations of the plants if they had wanted to. The posts were traded as personal assets of the leaders and the head of the Union was a patriarch.

The motivation for work in the company arises from the values of patriotism that can only be understood within the cultural background of the oilmen. On top of the original mission of the company, the public sector sends mixed messages regarding efficiency. There is no reward or punishment to motivate the efficiency of personal work. The oilmen try to do things better just for the sake of their personal satisfaction. It makes no difference to the company, or any of their employees, that things can be done more efficiently, and that costs can be reduced and profits increased. People with professional careers have the value of economic rationality and technical efficiency embedded in their vocational training. The company has no system of evaluation of meritorious performance. The oilmen have worked within the political environment in accordance to their professional rationality. The middle-technical managers have been able to act in such a manner because of their job security, at least until the previous administration.

4. Economic and political background

Pemex is the biggest oil company in México and has installations scattered throughout the country. The conditions of operation of the organisation changed dramatically during the administration of President Jose Lopez Portillo, who came into power in December, 1976. His government introduced an expansionary economic policy. In energy affairs, its central commitment was to increase the oil production platform. Pemex brought its extraction capability from 800,000 barrels per day in 1976 to 2,550,000 barrels per day in 1981 (Pemex, 1981). The ultimate goal of the organisation was to increase the production capabilities as rapidly as possible, with no other consideration. Pemex turned to be a source of financial resources to support the development of the country through the export of crude oil, gas, petroleum and petrochemical products.

By law Pemex investment projects were supervised by the Ministry of Energy (at that time SEPAFIN). But thanks to the personal relationship between the Director of Pemex, Jorge Diaz Serrano (an engineer from the private sector with very strong links with the oil industry) and President Lopez Portillo, the investment plans of the company were pushed with little regard for the formal authorization mechanisms. The goal was to achieve a massive growth of production capacity in the least possible time. The climate of operations is expressed in the following official statement:

> *The extraordinary dynamics imposed on the activities of the petroleum industry by the administration of President Jose Lopez Portillo, supported by the richness of our subsoil and by the efforts of all the technicians, workers and officers of the company, make it possible for the country to design a plan for its economic development, for the present and for many years to come, without any energy restrictions.* (Pemex, 1981)

The goal was achieved quickly but at tremendous costs with loss of control from the central administration. The operations of the company lacked proper co-ordination. The operations of Pemex were traditionally carried out through disconnected flows of information. The first formal information systems that were developed were mainly for administrative purposes. Computerisation of payroll began in the late sixties but each production centre developed its own proprietary system using mainframes. The rest of the information systems were mainly manual with a strong reputation of red tape, with tortuous bureaucratic procedures, and managed with a high degree of discretion from higher hierarchical levels regarding the definition of procedures.

In 1976 the company had 88,000 employees and this figure increased to 108,000 in 1980. Pemex was restructured and three major branches (subdivisions) were created to integrate other areas dedicated to planning and support activities. The administration systems were unable to cope with the oil boom. Due to the speed at which

the program was carried out, the company was unable to develop alternative administrative systems that could face the new challenges. The situation was chaotic at the central level although the operation site managed to have some type of control. This situation did create political tension with the central authorities responsible of controlling the budget.

With the company's only goal being to achieve a certain level of production, regardless of other considerations, the only financial data that mattered was the level of cash flow - the income earned by exports and internal sales. The oil wells were so productive that costs represented no problem in the environment of abundance created by the oil boom. Things could have been done more efficiently but that was not a point that mattered. In fact due to the richness of the wells the company figures were able to show productivity gains.

> *Proven reserves and crude production increased by 12 and 3 times respectively from 1976 to 1980, while staff increased by an annual average of 5%. Consequently operating expenses, which in 1976 represented 54% of the total sales incomes, in 1980 represented only 31%.* (Pemex, 1981)

All the investment plans were done by means of financial loans procured on the international markets and with high levels of imports of capital goods. During those years, the oil price was at its highest historical level. By the end of Mr. Lopez Portillo's administration the situation on the international market changed. Interest rates increased and this put pressure on the amount of interest that had to be paid to the international banks. The dollar devalued on the currency markets and the real cost of imports increased at a time when they were at a very high level. The international oil market showed signs of a glut, the price collapsed and with it the financial situation of the Mexican government. The public image of the company deteriorated even more due to the news published by the media regarding the way Pemex was managed with high discretion, abuse and corruption from all levels, including executives and union leaders.

The changes in the environment affected the company. The President appointed a new Director, Julio Rodolfo Moctezuma Cid (very close friend of Lopez Portillo with a strong political background), who remained in office until the end of the presidential term. His commitment was to save Lopez Portillo's public image. This administration lasted for about 14 months and, as with any other change of administration, operated with a high turnover of personnel from the executive level. In December 1982 Miguel de la Madrid came into power as President of México. The two central issues of his government policies were economic adjustments and auditing. Mario Ramon Beteta (a public administrator with a financial background) was appointed Director of Pemex. His management followed very closely the line of the central government policies. The policy of auditing was enforced even more with another change of administration in 1987. Francisco Rojas, an accountant and previously head of the Ministry Comptrollership, was appointed CEO of Pemex.

5. Institutional database

The institutional database was created during Diaz Serrano's administration. Pemex had started having a problem of public image due, in part, to the inconsistency of the data provided to the central government and the media. The inconsistency of the different figures was provoked by the chaotic situation that caused the oil boom, and by the lack of appropriate definitions of the terms. In 1980 the CEO created the Unit of Basic Information with the responsibility of presenting one sole version of Pemex's operation data.

The Unit started to develop a database and publish a monthly Report of Basic Information which was fed with reports coming from the operation divisions. These reports were produced with daily flows of information delivered by phone from the production centres. The figures were processed to provide monthly figures of operation for the Director of the company. The data had problems of inconsistency that were mainly related to levels of production with no financial evaluation of the processes. In 1987 the database was computerised on a mainframe. However, it was difficult to access data on this system. The database was to be used to produce the monthly report.

The administration of Rojas, that had a strong commitment to control the financial operations of the company, posed new demands on the flows of information. The Unit of Basic Information was located under the Subdivision of Planning and Co-ordination with broader functions and renamed as the Evaluation and Information Office. A new manager was appointed as head of the Office. He had vocational training in engineering and a post-graduate degree in operational research. He had a clear understanding of information technology and the importance of quality information to support planning, evaluation and reporting activities of Pemex. One of his many responsibilities was to look after the database. The CEO also gave the power and responsibility for the control and

production of institutional data regarding technical operations, budget, sales and production to the new Office.

The mission of the Office continued to be the integration of a unique vision of the operations of the company. It kept the responsibility of publishing the monthly Institutional Report that contained detailed indicators of the levels of production. The Office also dealt with the information that had to be delivered to five ministries of the central government: Energy, Treasury, Budget, Commerce and Comptrollership. There was the need to keep a consistent vision of the operations of the company.

The change of administration in 1988 brought new and urgent demands for information. The database had to support deep economic analysis of the operations. The new use of the information showed the need to improve the access, quality and quantity of information contained in the database. Analysis made evident the inconsistency of the figures. More detailed data was needed for the preparation of profit and loss statements of the company and the analysis of performance of the different units. The new information requirements were related to: levels of production, expenditures, distribution of production, depreciation of assets and the introduction of costing in accordance to the price determined by the international oil market. To facilitate the access, the database was migrated to a microcomputer environment. The validation of the information became a priority goal. The fundamental task of the information systems manager was the quality assurance of the data.

6. Administration of the database

By 1994, the institutional database has 50,000 series of monthly statistics and 2.1 million records of individual data organised by modules in accordance to the functional structure of Pemex. The amount of information that the database stores has been increasing in accordance to the demands of the users. Some records date back from 1980 - when the database was created - but most others are registered around 1988 when the controlling practices, promoted by Francisco Rojas's administration, were introduced. In any case, all the series are updated monthly. The contents of the database have been selected taking into account the requirements for the applications it supports; this explains why it is in a process of permanent growth and adjustment. The information contained in the database is structured to support the reports that need to be produced, as well as planning, evaluation and other types of analysis.

The series are organised in nine modules that correspond to a functional perspective of the company. The data is obtained monthly from 29 different documents; only six of them are delivered in magnetic form, with the rest of the information having to be captured manually. The documents that feed the database usually arrive 15 to 25 days after the closing date of the month that is being reported. The data is captured within 24 hours and is marked with a 'P' to denote that the data is preliminary. When data is validated, the records are marked with a 'C' to mean they are closing figures. The preliminary data can undergo various revisions in the subsequent months and are marked with an 'R' for revised. The database can easily be accessed using Windows, which is the office automation environment of Pemex. The data can be handled and exported very easily to a word processor, spreadsheet or presentation program.

The insertion of a new flow of information is established after a specific requirement from a user. When an analyst demands information that does not exist in the database, the Office of Evaluation and Information has to negotiate the requirement to establish a flow of information that can be feasible, relevant and useful. This negotiation is done taking into account the possible channels and flows of information.

When the new requirement of information is properly established, the negotiations with the area that will provide the information starts. First it has to be established whether the area can provide it. If it can, then the permanent channels of communication defining content, format, periodicity, means of delivery and the person responsible for the contact are established. Only under the fulfilment of these conditions is the record opened on the system.

7. Intelligent interface

The information is received through printed reports or diskettes by a specialist who checks the information to see if it is consistent and valid. This is a sort of 'intelligent interface'. The introduction of a specialist working as an intelligent interface has been the only way to assure the consistency and quality of the information. The company frequently faces changes in organisational structure and turnover of employees that affect the flows of information, in content and format. The specialist has to understand the information he is dealing with and make sense of the

flows of information being received. This is also a kind of an intelligent interface where the specialist has to understand the information he is handling. During this process, any inconsistencies in the data can be identified.

The personal characteristics of this interface are extremely important due to the two organisational cultures that Pemex has had, and the clash that has existed among them, since the administration of Ramon Beteta. The specialist has to be, in a sense, a hybrid that can handle both cultures. He has to be able to communicate with both the managerial level and the oil workers, and have abilities in both social relations and human communications. Due to the type of organisational culture, every section has in a sense been autonomous in defining its reporting practices. Every section has the right to define the type of reporting that suits its manager and change it whenever they consider it necessary. The intelligent interface is therefore able to work with the uncertainty and mobility of the context.

Due to the fact that the oilers' culture is based upon a very tight control on information as a source of power, the specialist has to be an 'oiler' in order to be able to penetrate their enclosure. When the boundary has been overcome, the negotiations are possible. The same control that hampers the flow of information, when trespassed, gives rise to the possibility of control over the negotiated flow, because there is a personal contact through which differences can be sorted out. The 'interface person' needs to be legitimate with the oilers values. He gains it by proving knowledge of technical operations and understanding of the information he is handling.

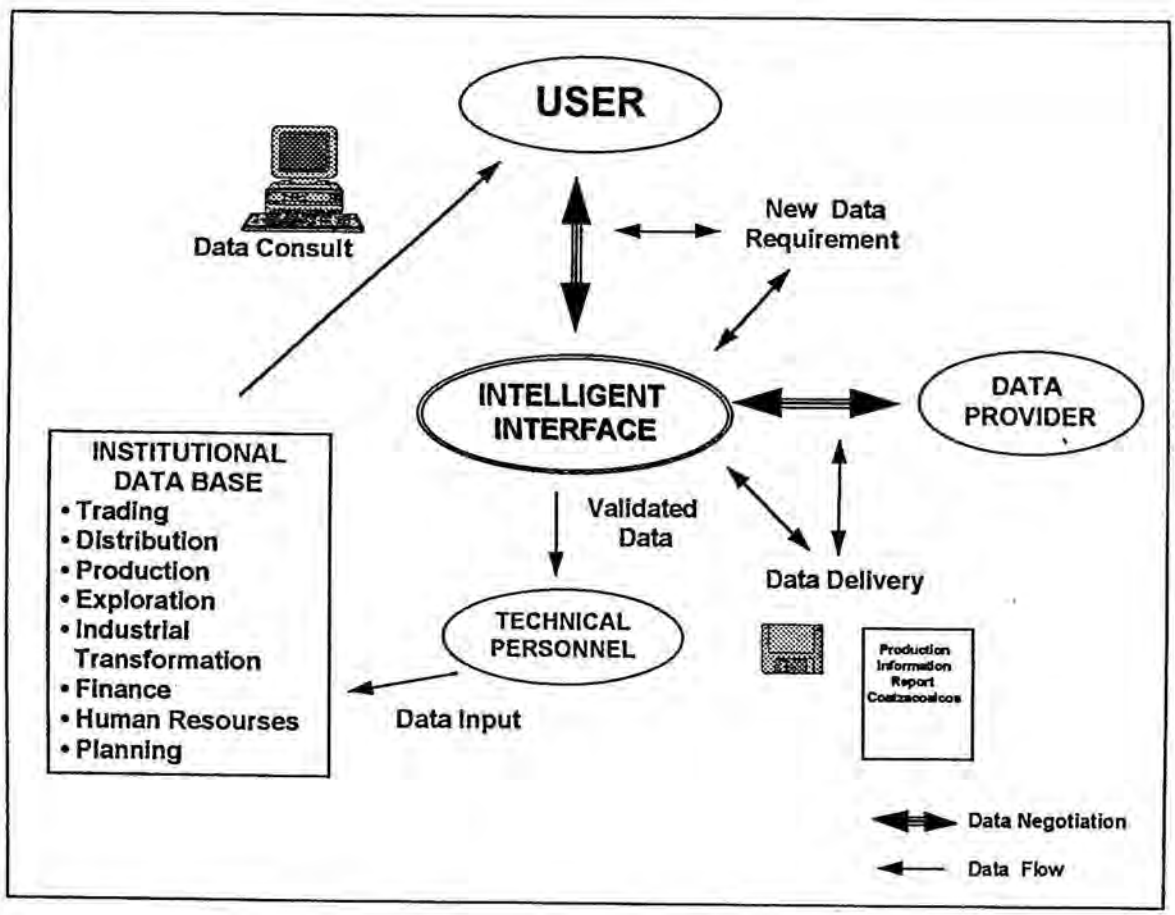

Figure 2: Interactions of the intelligent interface

The conditions for negotiating the information are very adverse. The specialist has to know and be able to manage the language of the oilers. He has to understand the conceptual background on which the people operate and never give judgement. Otherwise there may be problems in establishing the initial dialogue or the possibility of jeopardising contact already established. The specialist has to work on the assumption that the people doing the job know their work. He has to respect them. After fulfilling these requirements, he has to determine how his counterpart can help him in the work of collecting information. He may even need to train the provider of information on how to deal with the flow of data. The specialist has to have a deep understanding of what he is requesting in order to be able to present very clearly the problem he is trying to solve. If the counterpart does not understand him, it is because he himself has not achieved a proper understanding of the conceptual background and what information is truly required.

There is no way of forcing anyone to provide the information even though the development of the system has been a mandate of the CEO. In 'real life' information is usually obtained by the goodwill of employees that work in the areas that provide the data; one reason why the informal contact and the abilities to negotiate and communicate are so important. Due to lack of formal administrative systems, the quality of the information can only be assured through the interface that validates it permanently. The information collected from the various sources has to be based upon the information infrastructure of that particular area/division; that is, the data they produce for their daily operations.

It is a big task to maintain the continuity and consistency of the flow of information because the structural channels that should assure the quality and integrity of the information do not work. It has not been possible to create an institutional normalisation due to resistance and therefore there is no alternative but to use the information available and validate it to assure its quality. The normalisation of information is not a technical problem but political and has to be negotiated. There is however an urgent need to establish an institutional dialogue, something that has not been possible so far. There is also the need to train the users of the information; they have to understand the definitions of the concepts.

The control over the flow of the information is not done through a computer system, which could prove too restrictive and extremely difficult to develop in an organisation with Pemex's characteristics. The control is done through very strict data management procedures, tight definitions of the information requested, and the personal contact upon which the flow of data is established.

When the information is validated by the 'intelligent interface', which was made up of 7 specialists, it is passed on to the information technology team, a group of 4 people who have the responsibility to capture it in the database within the next 24 hours. The IT people have a very different profile to that of the specialists acting as the intelligent interface. Their vocational training is linked to computer science and they deal with the mean (the development of tools and technical excellence) not the product of the information system. There have been conflicts with the IT people who had to be kept in line and asked to align their mission with the Unit's goal. The group tried to subordinate the mission of the system, ie. to provide information. They wanted to make the development of the system more attractive in terms of their professional training.

During a period of worst conflicts with the IT people, the head of the Unit decided to change the name of the Office to reflect clearly what its responsibility and ultimately its mission were. The new title of the Office became Information Management Superintendent which encloses the idea that their work is to provide a service. The relations with the IT people did not improve as they could not easily grasp the fact that the technology has a role to play in helping solve specific and real user's problems. They also found it difficult to perceive the importance of assuring the quality of information.

The problem of providing easy access to the database became, at certain point, a bottleneck. There was no software available on the market that could fulfil the requirements of the system, and there were high budget restrictions on the development of an in-house application. It took almost a year to develop a system with Windows interface that allowed easy manipulation of the data.

8. Analysis

The development of information systems has become a tool for organisational development (Keen, 1981). This case analyses the restructuring of a database in which the status quo is not changed or even challenged. Much of the literature on implementation of information systems analyses ways to solve resistance to change (Keen, 1981; Angell

& Smithson, 1991; Smithson & Hirschheim, 1989); one of the ways among them being participative methods for the development of systems (Land & Hirschheim, 1983; Mumford, 1983).

In this case study the redefinition of Pemex's database, undertaken by the new manager of Basic Information in 1985, is analyzed as the development of a system. The manager used the resources he received and introduced radical qualitative changes in 1988 to satisfy the information needs demanded by the new administration. Features of Keen's tactical model of implementation can be identified: face to face contact, incremental changes and the existence of a leader with a high professional reputation (1981). These mechanisms are not intended to avoid resistance to change, of employees hampering the development of a system that would modify their work, but to validate the flow of data without disrupting the status quo.

The incremental change is implemented to assure that the growth of the database is not threatening its quality. The face to face negotiation can be identified in the relations of the 'intelligent interface' and the provider of information. The negotiation is done at the lowest level of the system from where the data is collected. The 'down up' approach of the participative method for the development of a system is also present in this case but in a different sense. The 'top down' approach of system analysis and design can be identified at the strategic level. The leader clearly established the rules of operation of the flows of information. Both approaches are needed to validate the quality of information.

The development of a system is a political process that challenges the control over information (Keen, 1981). In this case the leader was able to define a process that gave access to the data without disrupting the structure of control of the information flows. The development of the database can still be seen as a political process due to the need of permanent negotiations to validate the data.

The development of the database did not imply changes in the organisation but it provided the means to challenge it. Computerised information systems favour the rational perspective of life (Lowi, 1980). The quantitative approach has embedded the value of efficiency. In this sense the database has provided the means to challenge the rationale of the dis-functionality of Pemex. With quality information the organisation has been able to evaluate its performance using as yardstick the cost of the international oil markets. At the end the database did provoke an organisation change, not directly by its development, but in the implications of its use. In 1992 Pemex was restructured into four subsidiary companies.

9. Conclusions

Pemex is a company with a very strong organisational culture in which the source of power has been the control over information. The information systems in Pemex had been developed for operational purposes and the flows of information have been basically unstructured. From the technical point of view operations are done properly due to the professional code of practice of the engineers in charge of the operations. For many years the administration of the company did not follow the rationality of a capitalist enterprise which is based on the functionality of the market's law.

The rationality of efficiency and competitiveness was subdued by the forces of politics. The state-owned company operated with a type of dis-functionality with a very bureaucratic structure with islands of power. Within this context the development of an institutional database represented a major political process, more if it is considered that such an information system could open the possibility of introducing the market rationality in the management practices of the company.

The development of an institutional database defining formal flows from down-up would have taken the project nowhere. The information system manager, who had a deep knowledge of the organisation, realised that the only way he could succeed in developing a reliable institutional database was by putting to work the features of the organisation that seemed to be an obstacle for the development of the system. He created an intelligent interface to validate every step of the flow of information. He succeed in developing an adequate and efficient system within its context.

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MIS and systems analysis application in China: A case study from the Research Institute for Standards and Norms

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Abstract
This paper sets out the current experience in planning for and developing a management information system (MIS) for the Research Institute for Standards and Norms (RISN) in China. In the first section the problems encountered in the transfer of computer technology from the industrialised countries is discussed. Lessons are drawn out for comparison with the Chinese experience. In the section which follows, the Chinese situation is described specifically concerning the use of information systems within the public sector. The requirements of the Research Institute for Standards and Norms are described. Then the 'Multiview' methodology is set out, along with the reason for applying this methodology and its specific strengths and weaknesses. The section which follows this describes the manner in which Multiview was applied, to the specified business needs of the RISN. The participative input of the members of RISN and the current state of the project are reviewed. The final section presents some lessons and implications for both MIS and methodology development in China.

1. Introduction

This article is centrally concerned with the planning and adoption of management information systems in the Peoples Republic of China and reviewing the Chinese context in terms of problems associated with information systems development. There is a considerable literature relating to matters of technology transfer (e.g. see Bell & Wood-Harper, 1990; Bell & Shephard, 1990; Grant Lewis & Samoff, 1992; ITP Africa File, 1991; Siddiqi, 1990; Olukoshi, 1990; Forsyth, 1990). Much of this pertains to transfer to 'developing countries' and is not completely applicable to the case of China. However, it is the contention of the authors that there are principles which can be drawn from the literature which can be used as indicators of the success or otherwise of the transfer process. These indicators may well prove to be of interest in comparative analysis of the Chinese context.

Cyranek (1992), drawing on the work of Odedra (1992), sets out reasons for failure of information technology transfer and causes of this situation. Table 1 is drawn from his work and provides an overview of these issues.

Table 1: Developing country context and IS development

Issue	Observations on the issues
Feasibility	The discovery that projects are not feasible once embarked upon.
Automation	Context would indicate that the area under automation is not amenable to such procedure.
Consultants	These are usually westerners and are unsympathetic or ignorant of local context issues.
Training	Inadequate. Local staff are not able to deal with the technology being brought in.
Know-how	Sufficient only to run the system but not to develop it (e.g. issues relating to maintenance and extension of functions).
Software	Not available in the country.

The core issue, which is debated in the Cyranek article, is that of context and crucially the meaningful understanding of the requirements of context in which technology is being placed. This crucial issue is developed in the next section, which will also introduce the Chinese context.

2. The context: Background of the development of MIS at RISN

The theory and method of project appraisal were introduced into China in the late 1970's; at that time, however, only few scholars and institutes did research in the field. In the early 80's the Planning Commission, the major investment decision maker in government administration, perceived that a method was very useful in macro-decision making for large investment projects. Therefore (since 1985) RISN, on behalf of the Commission, began to organise the implementation of a method. After two years work the first version of Method and Parameters of Project Appraisal (MPPA), which guides the method and contains detailed parameters used in the appraisal, was issued by the Planning Commission in October 1987. Since then, the method and parameters have been widely used in the appraisal of investment projects.

The application of these theories and methods in China was encouraged by international agencies such as the World Bank and the UNDP as well as the Overseas Development Administration (ODA) of Britain. They have financed, jointly or independently, RISN in continued research into the theory and the improvement of method and parameters. The on-going information systems (IS) project funded by ODA aims to enhance the capability of calculating parameters in RISN.

There are two kinds of parameters in project appraisal:

1 parameters for economical appraisal (PEA), and
2 those for financial appraisal (PFA).

The PEA includes the discount rate, the shadow exchange rate, and the shadow prices for commodities, labour and land. The PFA involves the financial cut-off rate of return and the pay back cut-off period for the industry concerned. Because individual parameters relate to particular sets of information and specific professional knowledge domains, a requirement arose for an information system to cope with large scale data collection and information provision.

Since 1978 economic reform has spread throughout the Peoples Republic of China and the introduction of market mechanisms has accelerated economic development. At the same time, market information has changed much faster than before. This has meant that the timely adjustment and issue of parameters has become a high priority for national planning. For instance, the shadow exchange rate was 4 Yuan/$ in the first version, but the exchange rate in the black market peaked up at 7 Yuan/$ in 1988 when the highest inflation since 1949 was experienced. The need to adjust the parameters has become a key concern for the relevant institutes, banks and administrations. However, efficient tools for data analysis and information provision did not exist; for example, the revised parameters had to be issued in 1991 but were rapidly out dated and RISN had to arrange for a new round of parameter calculations.

Historically no parameters were calculated in RISN; they were all produced by related institutes. Thus RISN was dependent upon the availability of staff in these institutes. In order to issue the parameters in a timely manner, an information system which collected and processed data and regularly calculated the relevant parameters was needed.

Appraisal is a precondition of successful project implementation and monitoring is a vital aspect of project success. There was, however, no monitoring system on projects in China at the level of project administration. Project monitoring was therefore seen as being a vital element in any incoming information system.

To complete the requirements listed above, it was perceived that RISN needed an IT support system which included system planning and designing, and training of the system managers and operators, as well as selecting equipment and software.

3. An eclectic, participative methodology

The research and development work undertaken in RISN was based on thinking in two fields - action research (specifically from the field of agricultural planning in the developing countries) and eclectic analysis and design. This combination followed the identification of the types of problems set out in table 1 - specifically those pertaining to the weaknesses of consultancy and consultants.

The action research approach, as set out by Bottrall (1982) requires:

"1 Diagnosis. Research team to conduct independent, objective appraisal of client organisation's existing structure and management performance; subsequent joint discussion of findings between client and research team and agreement on definition of principle problems.

2 Action planning. Joint consideration of alternative courses of remedial action. Joint agreement on course of action to be followed.

3 Action taking. Client organisation to take agreed action; research team to stand back from action, monitoring clients decision making processes and their effects.

4 Evaluation. Research team to present evaluation of action programme to client for joint discussion.

5 Specifying learning. Client to extract lessons from evaluation of particular concern to itself (which may be fed back into further cycles of action planning, action taking and evaluation). Research team to extract lessons for general theory and for its application in action research programmes elsewhere".

It will be shown that this paper is centrally concerned with the second stage of the approach - action planning. The authors considered that future work would assess the development of the project. Within this general framework the Multiview systems analysis and design (SA&D) methodology was applied. The Multiview approach adopted here is as set out by Bell and Wood-Harper (1992). The basics of the approach are set out in figure 1.

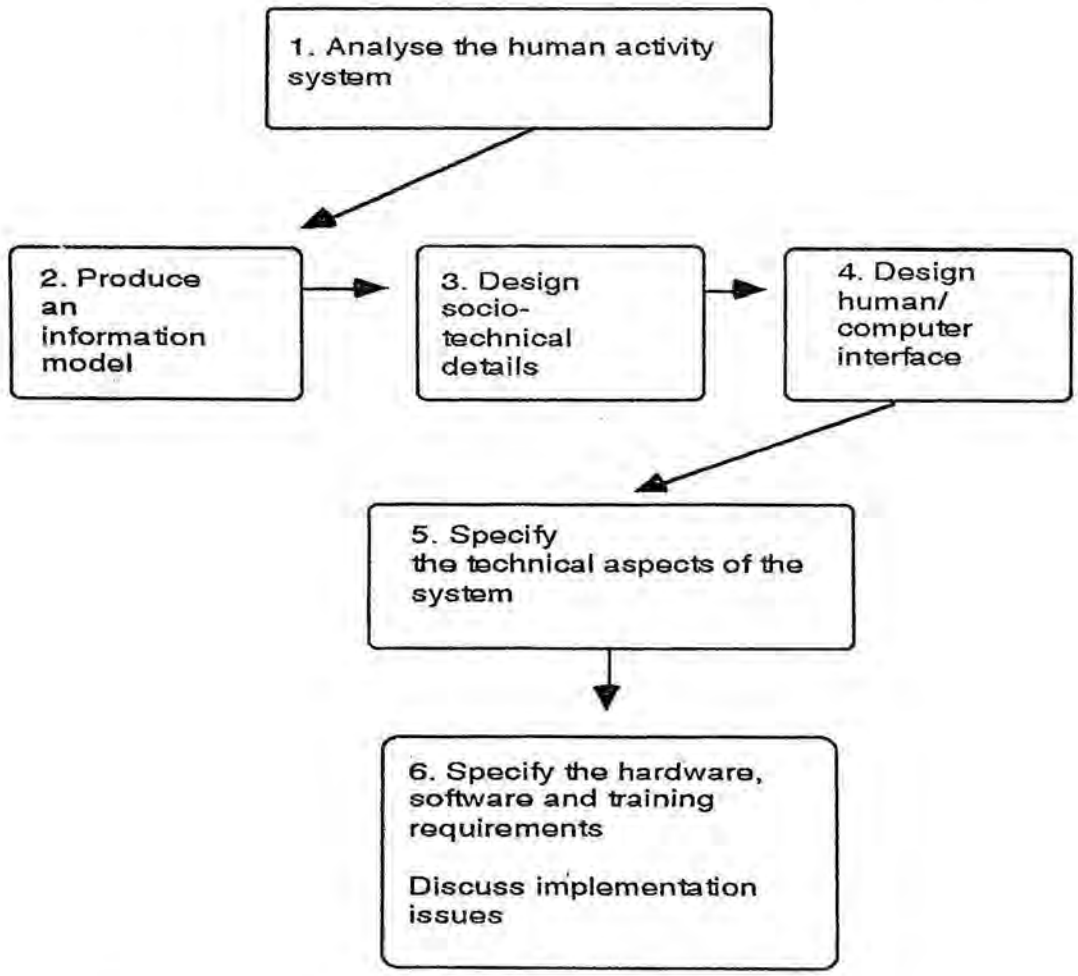

Figure 1: The Multiview rapid analysis and design approach

The methodology can be seen as fitting into the joint 'action planning' phase (2) of the action research framework. Briefly, the five stages have the following purposes:

1 Human activity system. This stage applies the soft systems approach in order to identify and extract major tasks and issues from the context. It provides the basis of understanding about the context.

2 Information modelling. Central to this stage are the identification of - entities, attributes, functions and events. These four components are the fundamentals of an information system.

3 Socio-technical design. Stage 3 highlights the combination of hardware software and people required for the information system.

4 Human-computer interface refers to the appearance and technical design of the interface that the user encounters, social issues of concern to the new system (including training details), and security matters.

5 Technical aspects are the component parts of the final system - the application as a whole, the database, the retrieval or reporting system, maintenance arrangements, management, and monitoring and evaluation (M&E) procedures.

6 Finally, and usually beyond the scope of analysis and logical design, we specify software, hardware, training and implementation strategies.

The following section outlines the manner in which the approach and methodology described above were applied in the RISN case.

4. Project progress

The development of the MIS for RISN started in January 1993. The MIS team (including RISN staff and an external consultant) completed the analysis and design in two weeks by use of a 'rapid'[1] variant of the Multiview approach (see Bell & Wood-Harper, 1992). During this stage the action research 'diagnosis' occurred first. This involved the consultant and local staff in a frank review of the existing organisation structure and business needs, vis-a-vis the generation of economic and financial parameters, the overall objective of the new system and the way in which technology might contribute to institutional development. The rich picture element of Multiview provided the team with a view of the project as a whole, the views and objectives of the donor and the recipient and the present tasks and issues evident in the RISN context. It was this critical and participative element of the diagnosis which provided the 'action planning' (stage two of action research). This was derived from the conceptual model, and informed the information modelling phase.

Throughout modelling the team had to take a long view of the eventual output of the process. With the political and economic face of China changing at a rapid rate, most aspects of the system have to be capable of being altered whilst leaving the fundamental structure of the MIS intact. Throughout the information modelling stage the team provided different views of the evolving system design. The tendency of the consultant on the one hand was to maintain the central 'indicator generating' capacity of the MIS. Often it appeared that the RISN interest was more focused on the wider computerisation ambitions of the Institute. The eclectic methodology provided tools for combining these views. Moving from soft to hard analysis and maintaining a participative and shared view of the systems progress, assumptions and misconceptions were unravelled and generally integrated into a consensus development model before they could become potential sources of difficulty.

With the information modelling stage complete, the fundamental (although intentionally vague at this stage) hardware and software for the proposed system was elaborated taking into account the size and volatility of the data items outlined in the information modelling. Project budget and prevailing preference on the part of the donor for packaged rather than bespoke software limited this to fast 486 PCs running database packages to be customised by RISN staff. The nature and degree of customisation would be decided by RISN staff following training which was also specified at this stage - RISN having an equal say in the nature of the training type and duration. Following specification of technology and training the planning went on to discuss interface. The main concern here resolved itself to dealing with Chinese character presentation in either DOS or Windows applications.

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1. The rapid approach of Multiview used in the research described here, has its foundations in the rapid appraisal methods advocated for rural development expounded by (among others) Chambers (1981) and Kumar (1993).

The analysis and design exercise led to the 'action taking' element of the action research and suggestions for the specific configuration of hardware and software, the detailed content for the training and a proposed development plan of MIS for RISN.

The important step for any system development is to acquire skilled staff who will be in charge of developing, operating and maintaining the system. For this reason two members of staff from RISN, nominated by RISN as visiting professionals, were sent to the UK to receive MIS training in the Overseas Development Group (ODG) at the University of East Anglia (UEA). The training included four phases: training in the use of the logical framework for project planning, software selection, MIS development and prototype design.

Phase 1 - The logical framework: The trainees studied the logical framework approach to project planning to gain an understanding of the relationship between goals, objects, outputs and activities (see Team Technologies, 1993). The logical framework exercise included planning criteria for the verification and assumptions related to each step. The logical framework is not a simple matrix; it can be used as an applied design tool for any project. It helps professionals to identify individual goals or objectives and the activities needed to achieve them. Setting the criteria and approach for verification provides a base for monitoring and evaluation. Because of its significance as an aid to clear thinking, the logical framework was assessed by the trainees as being one of the most important aspects of the training.

Phase 2 - Software selection: the trainees were asked to evaluate software packages (database and statistical analysis) which were suitable for developing the core of the computerised MIS for RISN. The report was to be the main reference for the software purchase. There are many packages in the software market. The trainees were to choose those which were able to meet perceived RISN MIS demand. The general principles of software purchasing applied were:

1 The software must have the functions to perform all the necessary tasks;
2 They should be able to run under the Chinese Operation System or Chinese Patch DOS, or have a Chinese version;
3 They were to be appropriate for the technical level of RISN staff;
4 Local support should be available from computer software vendors; and
5 Software must be sustainable.

The software evaluation occurred in six steps:

1 overview the functions and character of the individual software packages;
2 decide upon the indicators for the comparison;
3 rank these indicators;
4 do a benchmark test;
5 re-rank indicators after the test; and
6 decision making with justification.

For example, software selected included SPSS, MINITAB, LOTUS, TSP and INTERDYME as the candidates for the statistical package. The team described their advantages and weakness in the overview, set 16 functions or characters for comparison, and tested the capability and the speed to inverse a large matrix (142*142). Finally the team concluded that there was no single statistical package which could meet all requirements of the statistical function, and a purchase order which combines two statistical packages, SPSS and TSP, was proposed.

Phase 3 - MIS development: A ten week short course was designed to broaden the computer knowledge (for example SQL, fourth generation languages and geographic information systems) of the trainees. Key features of the training included introducing the theory and method for MIS and the Multiview methodology, which had been used in the initial MIS design and which was to be used later to refine the evolving RISN MIS.

The outcome of the training was set out in two reports by the trainees:

1 "A Preliminary Design of an Information Service System for Investment Project Appraisal", and
2 "The management Information System for the Economic Parameters in the Investment Project Appraisal in China".

Phase 4 - Prototype design: The two trainees considered that their work should focus on the detailed technical design for the future implementation. In the designing stage the trainees undertook the following:

1 Identifying five clients of the system (expert group, issuing institute, evaluators, researchers and RISN staff);
2 Describing the system outputs (economical parameters, statistical data, literature text and project monitoring) based on the requirement of the clients;
3 Clarifying the data source for system input;
4 Explaining the transformation procedure of the information from input to output;
5 Creating tables of the relationship among the models, parameters, software and data;
6 Planning the general framework of the system which included five modules: system management, statistical analysis, database, text base and project monitoring;
7 Stating the entity, events, attribution and data source for the individual databases and setting up the entity groups for the relevant databases;
8 Designing the technical and social human-computer interface (e.g. menu and screen design);
9 Outlining how to secure the system (physical security as well as software);
10 Formulating the way to maintain the hardware and software of the system;
11 Setting out the stages of system implementation; and
12 Clarifying anticipated problems and proposing solutions.

In February 1994 RISN provided an office with double-glazed windows and air conditioning for the MIS equipment and staff. Hardware and software were supplied and installed (the latter by a local company) and the MIS database is being set up.

Whilst recognising that we are at a very early stage in the evolution of an information system, the action research 'evaluation' to-date indicates that the experiences of the project are largely positive. The structure for evaluation used here is as related to issues in the process of technology transfer as defined by Cyranek (see table 1).

Table 2: The RISN context and IS development - following the first stage

Issue	Observations on the RISN context
Feasibility	The participative nature of the original analysis and design which took into account the institutional development required by RISN has helped to ensure that the system which was devised was locally maintainable, given certain provisos (e.g. that the system is effectively funded and that training inputs are not lost).
Automation	The RISN had considerable and variable experience of computerisation. The planning for the system had included considerable stress being laid on maintaining the effectiveness of the technology. Ongoing monitoring is planned through regular checking against logical frameworks.
Consultants	A learning team comprising the consultant and RISN staff operating under action research principles helped to ensure that the consultant worked participatively with local staff, acting as a resource in terms of facilitator, counsel and training guide.
Training	Context-specific training linked to the local sustainability of the system. Key staff received training which was in part at least planned by local staff.
Know-how	System and training were provided with a development plan for future years. This related to local skill levels and the developing capacities of the RISN.
Software	The major concern here was to ensure that all major software specified should be available in-country and conform to interface standards set by the RISN.

The MIS is in the early stages of development but the initial experience is positive both in terms of the immediate security and sustainability of the system and in terms of the information processing at present being undertaken by staff on the system. Further MIS development is now coming on-line.

5. Conclusion

This paper demonstrates the last aspect of the action research process - specifying learning. The implementation of "Investment Project Appraisal Assistant for China: Information Technique Component" is an ongoing and practical application of action research and the rapid Multiview approach.

The action research method provided local staff with the opportunity to take part in system design (during the initial analysis and design stage) and to feel a true sense of ownership of the final system (following subsequent training and development). In this manner the requirements of the owner and the clients were reflected and realised in the system design.

During analysis and design the Multiview approach provided RISN MIS staff with the capability to alternate their focus of attention between technical aspects and the system picture based on social requirements. Multiview appears to provide a degree of flexibility in inspecting the information system from the viewpoints of both technology and social preferences (the action research framework and local participation in analysis and design assisted in the achievement of this). The project was evaluated by the authors to be successful in indicating to RISN staff the number of factors which combine in information systems development. In the words of one of the RISN MIS staff:

> *The vital factor for system success is to have the sustaining organisation which owns and implements the system, the sustaining support from the director of the unit who budgets the system and manages the staff and skilled staff who run and maintain the system.*

In other words, it is the contention of the authors that the failure of information systems in many contexts are more likely to be due to the absence of a culture of sustainable information systems development based upon a participative review of the business needs of the organisation. In this context the indicator-based structure of MIS appears to provide a useful framework for design. Participative team work and social analysis in an eclectic analysis structure is essential in this regard and should be focused on in systems analysis of this type.

The system implemented at RISN constitutes a step further in the institutional development of the RISN. Although the system is in its early days and numerous potential problems lie before it, this exercise has indicated that technology linked to training and team participation can come together to provide a mix for sustainable systems development. In conclusion, the RISN has provided the team with a rich learning experience which will be built on in this and further analysis and design contexts.

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A pluralistic approach to information systems development: What can it offer to the developing world?

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Abstract
It is believed that revolutionary developments in information technology may allow developing countries to leap frog obstacles to development if they can successfully apply the new technology. However, many organizations in developing countries experience 'great hopes but many disappointments' from their introduction of computer-based information systems. Project failures are very often caused by a complex interlinking of technical, social and political factors. This paper describes an in-depth study, undertaken over eighteen months, into the development of an information system for a procurement office in the Philippines. Based on the findings from the investigation, the author suggests a pluralistic approach under which systems enquiry (Checkland & Scholes, 1991) and data analysis (Martin & Leben, 1989) complement each other to enable information systems development for developing countries to become more effective.

1. Overview of the research

This paper describes an in-depth study, undertaken over eighteen months, into the development of an information system for a U.K. owned procurement office in the Philippines. The research effort, using Checkland's (1985) term, is primarily concerned with the application of systems enquiry and data analysis (intellectual framework, F - a set of ideas by which we seek to make sense of the world) through action research (methodology, M - guidelines for investigation that require methods and techniques) in the area of information systems development (application area, A - some parts of the real world that are worthy of investigation) as shown in figure 1.

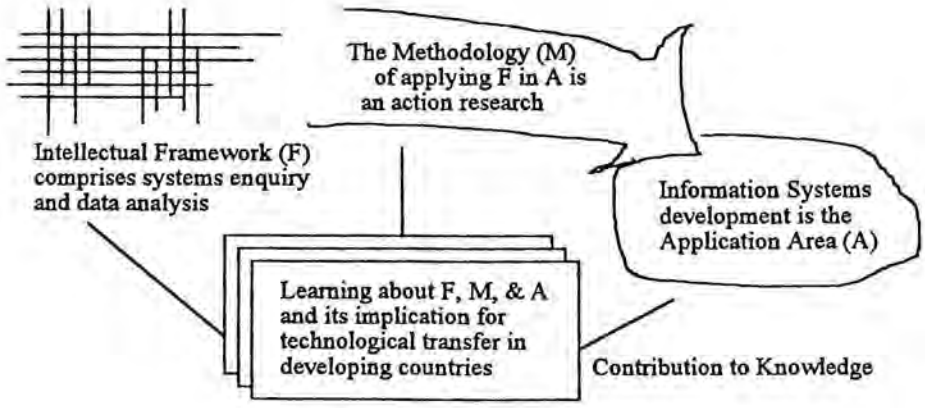

Figure 1: Overview of the research (adopted from Checkland, 1991)

Carrying out the above process allows possibilities of occurring amendments to F, M and improvements to A. The learning and reflection from changes are distilled and organized as a contribution to knowledge, which is, in this case, how systems enquiry and data analysis complement each other to enable the development of information systems to become more effective. This pluralistic approach is believed to be useful to developing countries for their implementation of informatics projects. The complementarity emerges from three paradigms:

1 A paradigm of pragmatism - The selection of information systems development methodology for developing countries may be based on practical application rather than ideological identification. A particular approach is useful to a particular problem situation. Thus, independent methodologies can co-exist in a broader setting which offers more choices to systems professionals.

2 A grafting paradigm - Developing countries should learn from earlier mistakes made by industrialized nations and recognize the interdisciplinary nature of information systems. It is desirable to merge and re-arrange the best features of different methodologies in a wider framework which can address effectively various issues involved in the implementation of informatics projects.

3 A learning paradigm - The adoption of information technology is an on-going process. This highlights the need for a multi-perspective epistemology which encapsulates an operation methodology to perform system development work, and a meta framework to make sense of the activities. It embodies reflection in actions and thus allows users in the developing world to learn their own ways to manage the flux of technological development with or without outside assistance.

1.1 Intellectual framework (F) - Systems enquiry and data analysis

The intellectual framework (F) for this research is developed from two disciplines:

1 Systems enquiry through the use of Soft Systems Methodology (Checkland, 1981; Wilson, 1984; Checkland & Scholes, 1991) and

2 Data analysis through the use of Strategic Data Planning Methodologies (Martin, 1982; Martin & Leben, 1989).

Systems enquiry is based on the philosophy that "*a whole is greater than the sum of its parts*" (Aristotle). One of its most important concepts applicable to information systems development is:

> *the correct place to start thinking about information systems is not with the information systems themselves (parts) but with the organizational activities (whole) that they are meant to serve* (Lewis, 1994).

Soft systems methodology (Checkland, 1981; Wilson, 1984; Checkland & Scholes, 1991) is a practical application of systems enquiry. It makes use of systems models to generate an appreciation and expression of different perspectives of the people involved in the organization about the information requirements to support decision making. Such information requirements, once identified, can be translated into a specification that is appropriate for the logical design to proceed.

Data analysis uses an alternative approach to 'engineer' information systems development. The view taken is that the inherent data structure existing in any enterprise is relatively stable. The computer program, network, hardware, operation process and organization will change, but the data stored remains unchanged. To benefit from such 'data independence', strategic data planning (Martin, 1982; Martin & Leben, 1989) should be derived in the same way as other strategic plans for human, financial and material resources. By applying a series of systematic analyses, analysts aim to understand the generic underlying nature and structure of the organization's data. The end product is a 'Strategic Data Model', upon which an information system is built.

In brief, systems enquiry is a 'soft' framework which concentrates on analyzing problem situations while data analysis is a 'hard' methodology which emphasizes the development of solutions. The former is perception-driven and "*helps the manager understand what information they need and how to use it*" (Mackness, 1989), while the latter is data-driven and "*provides the base of building a data structure capable of satisfying these information needs*" (Mackness, 1989). It is believed that systems enquiry and data analysis, even though driven from different paradigms, can be employed complementarily when practical works of information systems development are involved. And it is such a belief in methodology complementarity that started the research programme.

1.2 Application area (A) - Information systems development and the developing world

Information systems development (ISD) requires the use of techniques and tools to handle data structures, entity

relationships, design and programming, as well as conceptual guidelines which can cope with the complexity of human elements such as perceptions, languages, cultures and politics. This complex interlinking may best be addressed by adopting a pluralistic approach which brings together the competence, effectiveness and strength of different methodologies.

The environment of information systems development in developing countries is even more complicated than those of the developed world. According to Walsham, et al., (1988):

> *the problem of information systems development and use are often more severe in developing countries in terms of factors such as the current state of knowledge, availability, suitable equipment and infrastructure, lack of financial resources, shortages of technically competent personnel and constraints imposed by the social and political context.*

Many developing countries, while striving to adopt and apply information technology to enhance socio-economic development, many have experienced 'broken promises', 'great hopes but many disappointments', 'technical success but organizational failure' from the implementation of computer-based information systems. Very often,

> *there is a yawning gap between the promise of informatics project and its actual use and diffusion. To bridge this gap, developing countries have to harness the new technology and develop public policies and infrastructure (both technical and administrative) that would accelerate its wider and more profitable use.* (Hanna, 1991)

Due to greater unpredictability of various local conditions and human factors liable to affect the technology transfer in developing countries, a pluralistic approach (such as the one developed from systems enquiry and data analysis) which aims to tackle historical, technical, organizational, social and political issues involved in the introduction of information technology is believed to be highly useful.

1.3 Methodology (M) - action research

The methodological vehicle of studying the applicability of a pluralistic approach to information systems development has been action research. Action research is a self-constructing closed system (as shown in figure 2) whereby the activity of creating a methodology is followed by using the methodology. Using the methodology generates learning and from this learning it is possible to modify the methodology itself.

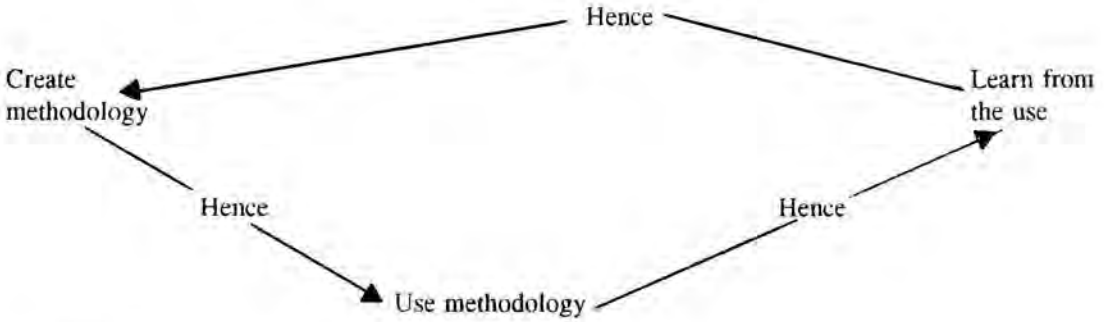

Figure 2: An action research cycle

Action research has to be judged by the even application of two criteria which relate, respectively, to the 'action' and to the 'research'. For the case studied, the former is an information system architecture delivered to the concerned organization. The latter is a wider framework which encompasses systems enquiry and data analysis for information systems development.

2. The case - Information systems development from a broader perspective

The applied framework is not another new methodology. Its elements are constructed and organized in such a way so as to facilitate practical information systems development from a broader perspective. The intervention work, as described pictorially by figure 3, follows two interacting streams of analysis: a logic-based stream of analysis, and a stream of culture analysis. The two streams inform each other, and together, they lead to the implementation of information technology projects.

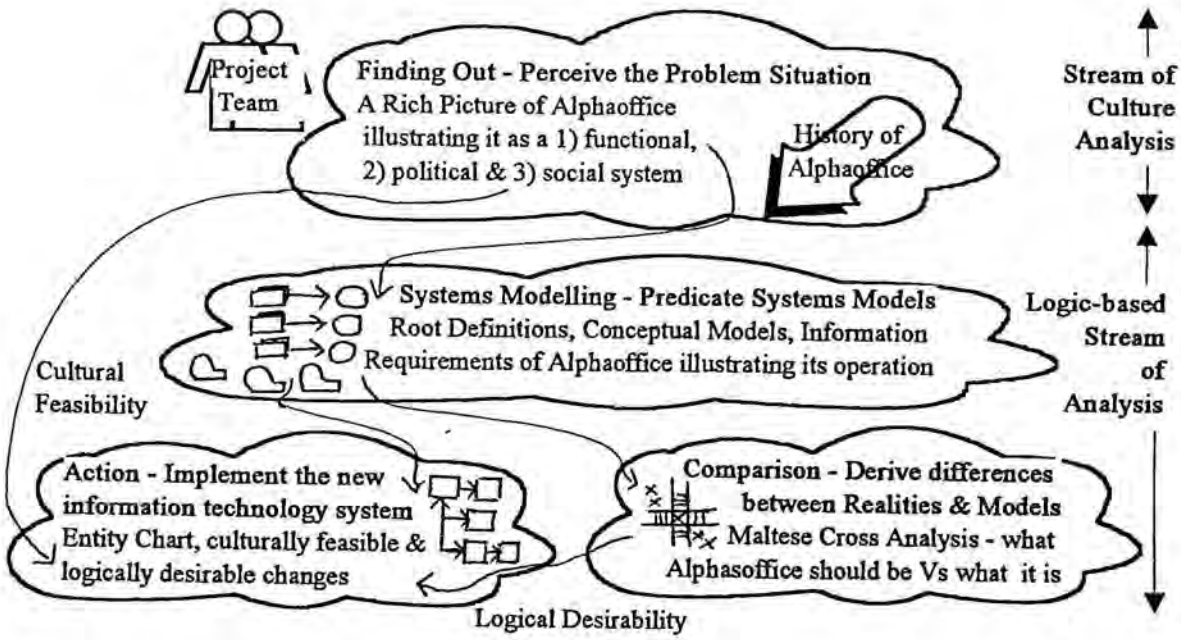

Figure 3: A wider framework for information systems development

2.1 Stream of culture analysis

Culture analysis (see figure. 3) is done by treating information systems development as a social and political process. It is believed an understanding of myths, meanings, values, norms, people's interests and the exercise of power are of crucial importance to the successful implementation of new systems and should be exercised throughout the cycle of project development.

The cultural dimension of systems development has been addressed from the very beginning of the project with the appointment of a Hong Kong Chinese (the author) as a member of a U.K. study team. The author is involved not only because she is interested in the application of Soft Systems Methodology and Strategic Data Planning Methodologies in information systems development, but also because Hong Kong has a cultural context which is relatively close to that of the Philippines (Hofstede, 1991, 1983). A Hong Kong Chinese is expected to be able to understand better the attitude and feeling of her oriental colleagues towards changes brought about by the introduction of new systems.

2.1.1 The problem situation

The concerned organization - Alphaoffice - is a procurement office of a U.K. timber trading company in the Philippines. Its management is of a typical small enterprise style where the owner (executive director) performs most of the functions with the assistance of a small number of close employees. Operation data are recorded on paper

and processed manually by responsible personnel into information when it is required. Such an information system worked very well in the 1970's when Alphaoffice was at its initial stage. However, as the scope and volume of business increase, the task of information management is beyond the capability of a human being's memory. Quite often, information such as shipment details, supplies availability, trade tariff and government regulations are missed, misunderstood and misinterpreted. Such human errors cause severe damage to the company. By the late 1980's, it had become clear that the existing manual systems were inadequate and the management board decided to introduce a computer-based information system to the office for more efficient and effective operation. The final decision, which was made in January 1989, marked the entry point of an investigation into the problem situation.

2.1.2 Alphaoffice as a social and political system

The cultural context of Alphaoffice is characterized by conservatism. Most members there have been working together for at least 10 years. They regard themselves (and are also treated informally) as key figures of the organization because of their seniority. Paternalism and stability are the norms of good management. The staff, in general, resist widespread automation. They feel that having so much information available on the computer, when it was previously accessible only to themselves, would reduce their importance in the organization. Information technology systems would probably bring over control from the head office. There is also no example of successful use of IT in the history of the organization. Computerization is thus viewed to be subjecting the well-established business to a needless risk. The situation is complicated by a fear of job losses resulting from the Philippine government's gradual ban on timber export in the late 1980's due to increased environment protection. Rumours have been circulated in Alphaoffice that the holding company has planned to shift most of its purchasing activities from the Philippines to Indonesia where there is still no restriction on timber trading and automation is a management action to reduce manpower of the office. Such a social and political atmosphere makes the introduction of a technologically based project very difficult.

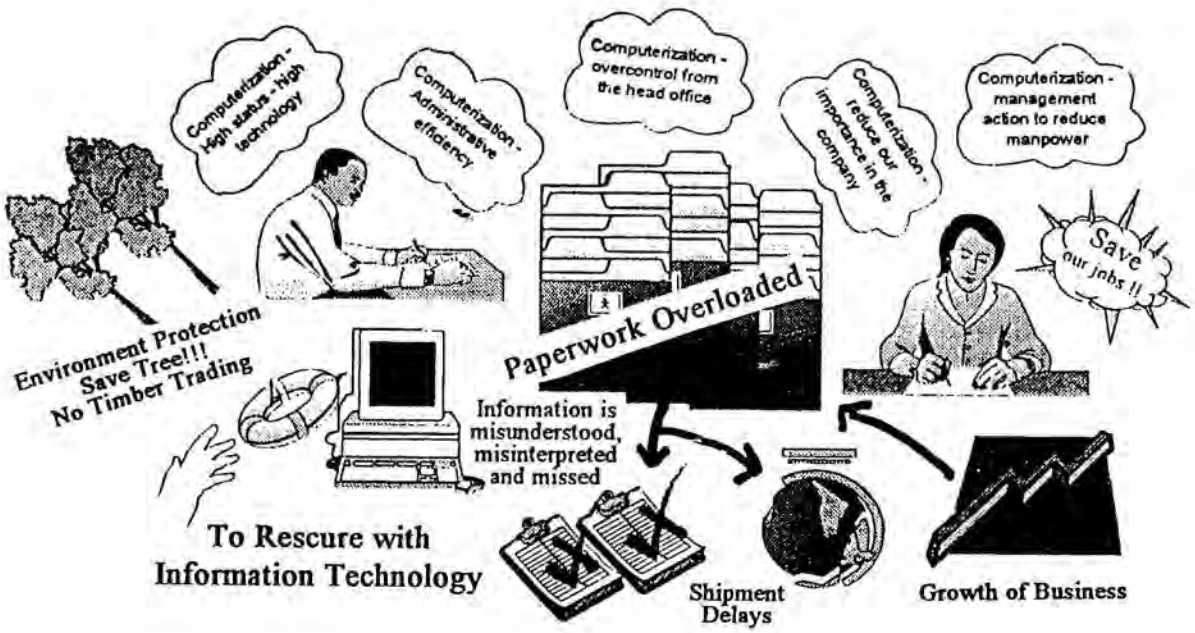

Figure 4: A rich picture of Alphaoffice

As pointed out by Walsham et al., (1988):
the development of computer-based technologies hinges on many human judgments and actions, often influenced by political interests, structural constraints, and participants' definition of their situations.

The messy and problematic situation of Alphaoffice at the start of the project is compiled and summarized on a 'rich picture' (Checkland, 1985) as shown in figure 4. This rich picture has been proved to be a useful tool for assessing the organizational context of the undertaken systems development project. It enables members of the office to visualize and discusses their roles in relation to the computerization. Worries of individuals, differences of opinions and potential conflicts are expressed and resolved by pointing at the picture and trying to get them changed. It also helps the executive director (who commissioned the research study) to sort out his own thoughts and explain the fundamental issues to the project team.

2.1.3 Cultural change in Alphaoffice

The enquiry process of Soft Systems Methodology, however, has provided a learning system which guides the staff members of Alphaoffice to look at the problem situation from different perspectives. Information technology can be seen as an opportunity rather than a threat. The chance of optimum utilization of computing technology by the Philippine procurement office is extremely high because most personnel there are literate, trainable and conversant in English, the language of computer programming. The prospect of financial gain from administrative effectiveness and the notion of high status attached to high technology are also attractive to everyone in general. Such a fresh look at the problem situation also alters all members of Alphaoffice that the present stability may not last forever. The technology is changing, the competition is changing, the business environment is changing and sooner or later, Alphaoffice has to undergo necessary changes for survival. The time to plan any change, when there is both the finance and time to do it, is in Alphaoffice's case now. Every member of the staff eventually regards changes as an inevitable phenomenon. Discernible changes in perceptions at an individual level have led to cultural change at an organization level. The social atmosphere at Alphaoffice has gradually moved from conservatism to relatively liberal. It is under such a new and liberal cultural context that technologically based innovations are perceived as a meaningful and feasible solution to the problem of deficient information provision.

2.2 Stream of logic-based analysis

The implementation of changes, argued by Checkland (1981), "*must meet two criteria simultaneously - cultural feasibility and systemic desirability*". Cultural feasibility asks whether a particular change is feasible for the characteristics of the situation and the shared experience of the people in it. This is done by examining the cultural, social and political dimensions of systems development as discussed before. Systemic desirability means that any change to be implemented must not violate, contradict or run counter to the logic that has gone into the systems analysis. The stream of logic-driven analysis of the applied framework (as shown on figure 3) comprises the phases of systems modelling, comparison and data analysis.

2.2.1 Systems modelling - The operation and information needs of Alphaoffice

Systems modelling makes use of a particular kind of systems model, 'human activity system' (Checkland, 1981), to represent a particular view of the problem situation. Each human activity system is defined by a root definition, which is constructed by consciously considering the six elements of mnemonic CATWOE. CATWOE (see figure 5), in plain English, explain "*who is doing what for whom, and to whom are they answerable, what assumptions are being made, and in what environment is it happening?*" (Avison, 1988). Each root definition is then expanded into conceptual models which exhibit the "*minimum and necessary activities that the system must do in order to be the system so defined*" (Checkland, 1981). They consist of verbs describing the activities which have to be there in the system named in the root definition.

C	Customer	Who would be victims/beneficiaries of the purposeful activity?	Whom
A	Actor	Who would do the activity?	Who
T	Transformation	What is the purposeful activity expressed as: Input-T-Output?	What
W	Weltanschauung	What view of the world makes this definition meaningful?	Assumption?
O	Owner	Who could stop this activity?	Answerable
E	Environmental	What constraints does this system take as given?	Environment

Figure 5: Six essential elements of a root definition

Since a problem situation can be interpreted in many different ways, there are always different sets of root definitions and conceptual models. Staff members of Alphaoffice were invited to participate in a brainstorming session during which every one was asked to talk about the problem situation and provide a statement of the purpose which s/he perceived for the running of the organization. After several debates and discussions, the project team came up with a consensus root definition and primary tasks model, which are illustrated by figures 6 and 7 respectively.

A timber acquisition system

An Alphaoffice owned system for the acquisition of timber through the placement of orders with selected suppliers so that timber supplies can be maintained at standard quality and quantity, within the constraints of company policy, timber availability and government intervention.

CATWOE	
CUSTOMER:	Alphaoffice's holding company, timber suppliers.
ACTOR:	Staff members of Alphaoffice.
TRANSFORMATION:	Timber owned by suppliers ⟶ Timber owned by Alphaoffice's holding company.
WELTANSCHAUUNG:	Maintaining timber supplies at standard quality and quantity is essential for the holding company's operation.
OWNER:	Alphaoffice's holding company.
ENVIRONMENT:	Company's policy on expenditure and inventory, timber availability, government's intervention in timer trading.

Figure 6: Consensus root definition of Alphaoffice

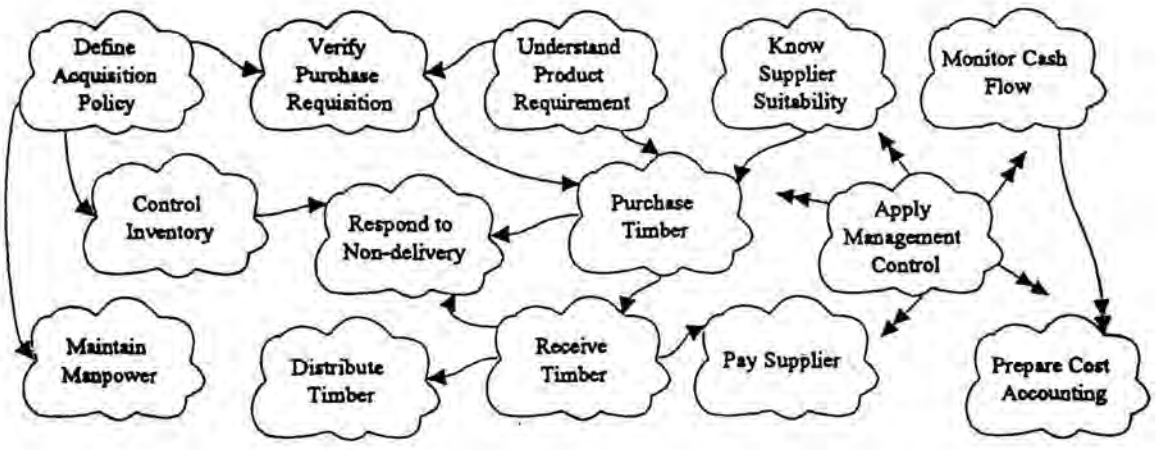

Figure 7: Consensus primary task model of Alphaoffice

The consensus primary task model, once constructed, *"forms a cogent basis for an information model upon which the information system design process itself can be related"* (Checkland & Griffin, 1970; Wilson, 1984). The conceptual information requirement of Alphaoffice is derived by analyzing each activity in the consensus primary task model and examining what information categories should be available to enable someone to take that action (Checkland & Scholes, 1991). This activity model is thus converted into an information flow model.

2.2.2 Comparison - What Alphaoffice is vs. what Alphaoffice should be

The information flow deemed necessary to support Alphaoffice's operation is then compared with the existing data provision. A revised version of 'Maltese Cross' (Wilson, 1984) is used as a device for comparison. The Alphaoffice Maltese Cross (figure 8) consists of two segments:

1 a north-western segment, which represents the necessary information inputs to support Alphaoffice's operation; and

2 a south-eastern segment, which exhibits the data generated from Alphaoffice's current processing procedures.

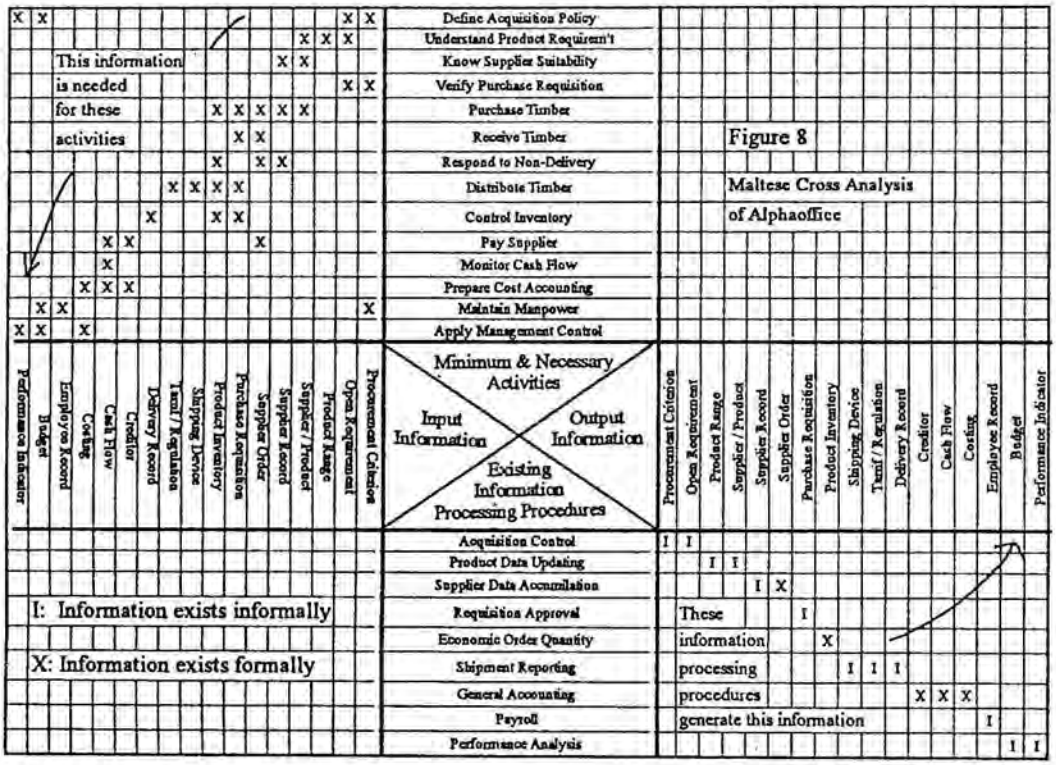

Figure 8: Maltese cross analysis of Alphaoffice

By relating the south-eastern segment to the north-western segment, the project team is able to compare what is provided with what is required. The south-eastern sector of Alphaoffice's Maltese Cross is very different from the north-western sector, and according to Wilson (1984), *"where there are differences, there are possible reasons for a problem to exist"*.

The operation of Alphaoffice, as understood from the analysis, requires a massive amount of information inputs, such as owner's expectation, resource availability, procurement policies, product knowledge, supplier position, the environmental constraints, etc. All this information, amazingly, does exist in Alphaoffice, not through

a formal provision channel, but through the executive director's experience, knowledge, awareness of the environmental situation and utilization of external data. We can thus say that the strategic information exists in Alphaoffice, but not a proper system to provide it.

The provision of operation data, in contrast to that of strategic information, is very comprehensive. Alphaoffice has a regular set of reporting procedures that produce over 20 varieties of internal reports such as balance sheet, profit and loss statement, inflow/outflow cash, statutory overheads, wages reconciliation, inventory breakdown, timber on water, timber on quay, etc. on a daily, weekly or monthly bases. Technically, Alphaoffice is very strong in performance reporting - there is a record of nearly every activity. The internal reports are all sent to the executive director for review and distribution to concerned executives for necessary actions. However, being overloaded with an abundance of 'irrelevant' information (irrelevant to the executive director management level), the executive director only looks briefly at the balance sheet and monthly profit and loss statement and defers scrutiny of the remaining reports.

Alphaoffice, like many small enterprises, is organized around the business genius of a few men. Nevertheless, there will be a time when the genius must be passed on, and the executive director, who is responsible for nearly every managerial decision and planning is by no means immortal. Alphaoffice must generate a mechanism whereby it can continue its effectiveness and efficiency in spite of personnel changes and transferring information from human brains to systems. This mechanism, logically, is a formal set of information processing procedures.

2.2.3 Entity analysis - A data model upon which Alphaoffice's information system should be built

What seems to be logically desirable and culturally feasible for Alphaoffice is to derive a technologically based system that will yield the information flow required by the structured set of activities relevant to its operation. However, the information categories, as shown on the north-western sector of figure 8, are not precise enough to guide systems design. What has to be done is to identify *"the data structures that could embody the information categories which characterize these information flows"* (Checkland & Scholes, 1991). Based on the algorithms provided by Strategic Data Planning Methodologies (Martin & Leben, 1989) and the project team members' human adjustments, entities which express the information categories required by Alphaoffice's operation are identified and their relationships are established.

The project, at this point, moves from general to specific, from ill-structured to fairly defined and from analysis to design and implementation. The cycle of the pluralistic approach is completed by taking feasible and desirable actions to implement the new information system.

3. Learning - A pluralistic approach and its applicability for developing countries

The learning distilled from the eighteen months' systems development project is that systems enquiry and data analysis complement each other in the context of information systems development. This multi-disciplinary approach is useful for implementing informatics projects in developing countries. The complementarity between systems enquiry and data analysis emerges from three paradigms: a paradigm of pragmatism, a grafting paradigm, and a learning paradigm.

3.1 Towards a paradigm of pragmatism

'All roads lead to Rome'. Systems enquiry and data analysis can be compared to two different means of transport to the same destination. Rather than being competitive, they can co-exist in harmony. With data analysis, doing systems development is like travelling in a tram. The analyst feels comfortable that the journey is on the right track and is certain that she can produce a defensible 'entity chart' upon which systems design is based. The outcomes seem to be automatically right because the intervening steps have been right. With systems analysis, doing systems development is like travelling in a bus. The analyst is not expected to follow a prescribed set of procedures and can go anywhere with no constraint. Elements of the methodology such as culture analysis, root definitions and conceptual models are all means to break down a systems developer's mental tramway which restricts her scope of analysis. If methodologies of information systems development are analogous to different roads to Rome, then data analysis is a straightforward and comfortable route, while systems enquiry is more uncertain, yet it not only guides you to Rome but also makes you think why you have chosen to go to Rome. The choice is up to information systems developers.

For developing countries, the choice of information systems development methodology will probably be based on practical application rather than ideological identification. A quick and dirty way to attain technological capability is "*to start with the end and end with the beginning*" (National Technology Transformation Policy of Indonesia). That means the focus is placed on how a technological innovation works rather than what it is. For practical reasons, developing countries may consider all development methodologies as one, whether soft or hard, systemic or systematic, subjective or objective, interpretive or functionalistic, positivist or phenomenalistic, the only difference being whether it is applicable or not. A multi-disciplinary approach based on a pragmatic paradigm can be taken by thinking that there is an invisible equipment bag containing independent and co-existing methodologies. With a creative flair and open-mind, an analyst can draw an appropriate constitutive trajectory to the problem situation and choose an appropriate methodology accordingly (Flood & Carson, 1988). The crucial decision is how to select an appropriate approach by the determination of requirements, rather than the selection of a methodology itself. It is important to be situation-oriented, rather than methodology-oriented.

3.2 Towards a grafting paradigm

Information systems are believed to be not only technical systems which have behavioral and social consequences, but also "*social systems which rely to an increasing extent on information technology for their functions*" (Hirschheim, 1985). The success of information systems development requires a joint effort from different disciplines such as computing, engineering, systems, psychology and philosophy. Project failures very often result from adopting a narrow, uniquely technical approach which ignores the realities of the organization which an information system is designed to serve (Smithson & Land, 1986). Developing countries may benefit from not being first to implement information technology and learn from the earlier mistakes made by more advanced countries. A methodology, to be effective, should address issues of technical skills as well as "*behavioral awareness, concern for human values, at a higher level, organization and political skill*" (Walsham et al., 1988).

Systems enquiry and data analysis, as discussed before, are equally effective for information systems development. The former is comprehensive in the scope of analysis while the latter is reliable in systems design. This finding highlights the desirability of combining the two methodologies so that analysts can kill various birds (multi-dimensions of systems development) with one stone (one application). Figure 9 suggests a possible way of merging systems enquiry with data analysis: here, systems enquiry is used at the early stage of systems development. It allows human, organization, social and political problems to be found at the front-end, where they are more easily addressed, rather than at the end of the development, where they are disastrous. Once a consensus view of the situation is reached, rigorous techniques from data analysis can be applied to construct a corporate data model as a blueprint for subsequent phases of design and programming. The marriage of systems enquiry and data analysis is based on a grafting paradigm which adopts a philosophy that the best features of different methodologies can be tailored and re-arranged in a purpose-fashioned framework.

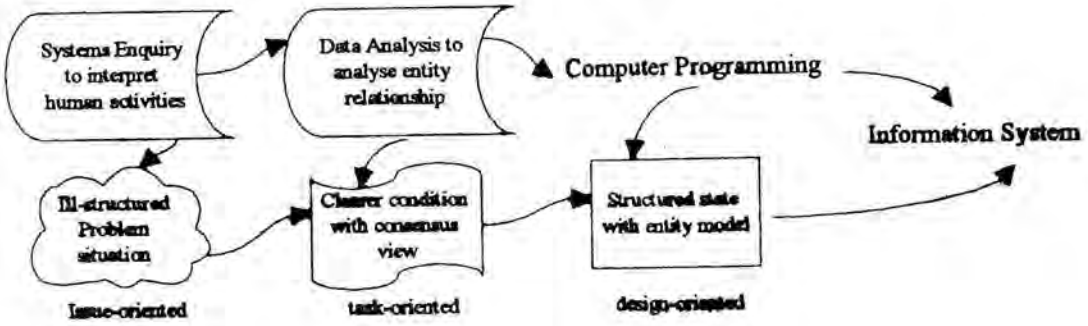

Figure 9: Merging systems enquiry with data analysis

3.3 Towards a learning paradigm

Many organizations in developing countries use outside consultants to develop and implement technological innovations. This makes technological transfers quite dependent upon transient 'expats' who are sent to show them how to use the technology (Smithson & Land, 1986). The expats are chosen mainly because of their technical skills and do not have much commitment to their host organizations. It is not surprising that much expatriate-initiated work does not 'stick' in developing countries. The systems are very often unmaintainable once the expats have returned home (Smithson & Land, 1986). Information systems development is an on-going process. Technological transfer must be a "*transfer of knowledge rather than physical devices*" (Smithson & Land, 1986). Technology knowledge should thus include some guiding principles with which users can learn their own ways to continuous systems development.

Systems enquiry, because of its interpretive nature, can embody reflection in actions performed via other more structured methods. With a broader setting, systems enquiry and data analysis can be applied simultaneously as shown in figure 10. Here, data analysis is used to plan and develop a system for an organization. Systems enquiry is performed inside one's head to make sense of the experience. It is employed unconsciously to increase the degree of consciousness of the project team and help them become more alert to what they are looking for, to assess what to do, to evaluate the consequences of surrounding environments and to unfold choices of activities and the ways they are handled. Users can start mentally from what has been done with data analysis and map it on to systems enquiry. The latter provides a ready made structure for reflection to be extracted and organized. This meta epistemology takes the stance of a learning paradigm. It allows users in developing countries to learn their own ways to develop and implement information technology. The usage will continue to be extended through time in response to social and economic changes. It lasts as long as the situation requires, with or without the assistance from developed countries.

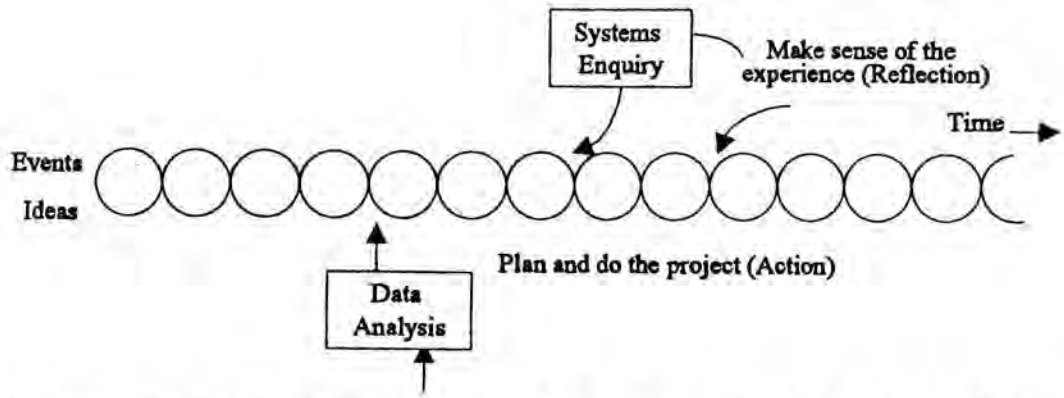

Figure 10: The history of IS development as a flux of interacting reflections and actions; adopted from Vickers' (1983) view of history as a 'two stranded rope of events and ideas'.

4. Conclusion

The result of the research implies that complementarity occurs when different methodologies from different disciplines are employed in information systems development. Systems enquiry and data analysis are viewed not as separate, self-contained methodologies to information systems development, but as approaches which can work together, and by doing so produce more assistance for information systems designers. An informatics project in developing countries, because it consists of technological, social and political problems, is too complex to be tackled by a single methodology. Multi-disciplinary teamwork, drawing together the competence, effectiveness and strength of different epistemology is believed to have advantages over uni-disciplinary endeavour. Complementarities of various approaches should be utilized by developing countries to enhance the effectiveness of their technological transfer programmes.

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Mexico's national health information system analysis: Identification of a problem situation

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Abstract
The purpose of this work is to present the results of system analysis work carried out on Mexico's National Health Information System - Sistema Estatal de Informacion Basica (SEIB). SEIB was developed in the mid-eighties; owned by the Ministry of Health, it is the official information system of the health sector and provides data and information regarding the vital statistics, health services coverage, prevention and control of communicable diseases, and human resource availability. Through observation, review of the literature and personal communications with users/producers of information, a 'problem situation' regarding the overall functioning of the information system was perceived. Different elements and factors such as: time, bureaucracy, data collection, user education, data interpretation, feedback, reliability, and social impact were identified as relevant for the analysis. These elements helped to establish a 'rich picture' of the situation. Problems could then be classified according to the actors involved; the information sources/resources; and the environment. The implications of this analysis to the health system and to information systems research are described.

1. Introduction

With a population of approximately ninety million, Mexico ranks a significant place among the highly populated countries in the world. Nearly 130,000 physicians provide both public and private health care services throughout the country. By 1987, approximately 90 per cent of the population was covered by the national health service.

Being a Republic, Mexico is divided into thirty one States and one Federal District, set up in the capital, Mexico City. The national health service is mainly provided by the Ministry of Health (SSA), the Social Security Mexican Institute (IMSS), the State Worker's Social Security Institute (ISSSTE), and the Family, Integral Development Organisation (DIF). Other minor institutions provide health services to more specific targeted users groups such as Mexico's oil company, PEMEX, and the naval and armed forces.

All institutions, although independent from each other, must implement the 'General Health Law Act' and the 'National Health Programme Act' as published by SSA which functions as head of the health sector. An approach to integrate the four main health institutions started in the early eighties; however, a new trend to co-ordinate and decentralise services only started taking place under the last administration.

Decentralised from SSA, Mexico has nine National Institutes of Health which have become centres of excellence in their respective fields; these include paediatrics, cardiology, nutrition and internal medicine, oncology, neurology and neurosurgery, pneumology, perinatology, psychiatry, and public health.

SSA and DIF offer comprehensive services free of charge to the whole population while IMSS and ISSSTE serve only the affiliated population. All four institutions are represented in each of the thirty one States and the Federal District. By 1988, a health survey showed that health service demands by the population corresponded to a high extent on IMSS (33.5 per cent) and the private sector (36.7 per cent); and in a lower scale on SSA (12.6 per cent) and ISSSTE (6.9 per cent).

The major sources of funding for the health sector are general taxation and insurance contributions. According to previous planning and budgeting proposals, the Ministry of Planning and Budgeting allocates a sum to SSA who then distributes the money to local health authorities. Health expenditure as related to Gross National Product has decreased from 2.24 per cent in 1978 to 1.63 per cent in 1987 (Valdes, et al., 1988). During the period

1978-1986, SSA spent 70 per cent of its budget on curative medicine, 6 per cent on preventive medicine and human resources capacitation, and only 1 per cent on research and development activities (Soberon Acevedo, 1987).

Throughout the years, the health status of the Mexican population has experienced a transition from parasitic and infectious diseases to chronic pathologies. While in the fifties the parasitic and infectious diseases were predominant with over 30 per cent of death rates, by 1982, they represented only 12.2 per cent. On the other hand, an increase in cardiovascular diseases and accidents was noted after the seventies. This change may be related to the significant migration of the population from rural to urban settlements, particularly after the sixties.

2. Mexico's health information system (SEIB)

Mexico's Health Information Programme derives from the National Health Programme Act, published in 1982. One of the main components of the National Health Programme is the National Health Information System (SEIB) which collects data and information from the thirty one States of Mexico, the Federal District, the National Institutes of Health, and other administrative units. Other components of the National Health Programme are the information systems derived from IMSS, ISSSTE, DIF, naval/armed forces, private practice and other governmental sectors.

SEIB was launched in March 1986 as part of a strategy to improve the SSA statistics and as a tool to strengthen the SSA programmes nationally. SEIB's main goal was to generate homogenous, continuous, prompt, reliable and relevant statistics concerning health problems; and to obtain data regarding existing resources and health services so as to support the decision-making processes at the structural level of health care.

Five specific objectives were defined. These were:

1 To provide access to indicators regarding the health status of the population and the evolution of public health issues;
2 To support the planning, programming, implementation and evaluation processes of national health programmes;
3 To support the operations of the different health units;
4 To collaborate in the meeting of health goals and services through informed decision-making mechanisms; and
5 To support research and development activities.

The strategic lines of action to obtain the above mentioned goals included the promotion of debate, dialogue and communication among different parties, the generation of instruments such as technical manuals, instruction norms, procedures, and the capacitation of the human resource available so as to obtain the skills in the management of data and information.

3. SEIB's structure

SEIB's structure was based on the following five modular sub-systems:

1 Population and health coverage. This module considered data regarding birth/death rates and population covered by the national health system.
2 Health services resources. This module included human, material and financial resources.
3 Health problems. Here, morbidity and death rates by cause were included.
4 Delivery of health care services. This module considered preventive and curative services, both, at the institutional and community/rural levels.
5 Health surveys. Here, home and establishments were included.

4. SEIB's organisation

SEIB's operation was designed to work at four levels:

1 Central level (Mexico City). Here a General Director/office is responsible for the overall organisation and management of SEIB at a national scale.
2 State level (Thirty one Mexican States and the Federal District). Here the Ministry of Health at the State level functions as head/responsible for the running of the system throughout the State.
3 Jurisdictional level (218 nationally). Here, each health jurisdiction owns a 'statistics office' responsible for operating the system; and

4 Health unit level (7,017 nationally).

The operation of SEIB starts at the 'health unit level' with the generation and collection of data. This is done through different procedures, integrating statistical reports. The frequency of such reports varies according to the specific characteristics of each sub-system module. The reports generated at the 'health unit level' are sent to the 'jurisdictional level', where they are concentrated and analyzed. Once analyzed, they are sent to the 'state level' where they are concentrated again and used for decision making in the health planning processes. Finally, on the last week of each month, the reports arrive at the 'central level' where different reports are published and distributed nationally.

Data is captured through different formats allowing for the manual or automated processing of information. A computer was assigned to each health jurisdiction in an effort to capture and process all the collected data. Six products are obtained from the analysis of the information sent to the 'central level'. They include catalogues, directories, reports and statistical bulletins. Figure 1 illustrates the implementation of SEIB activities at each of the four levels of development.

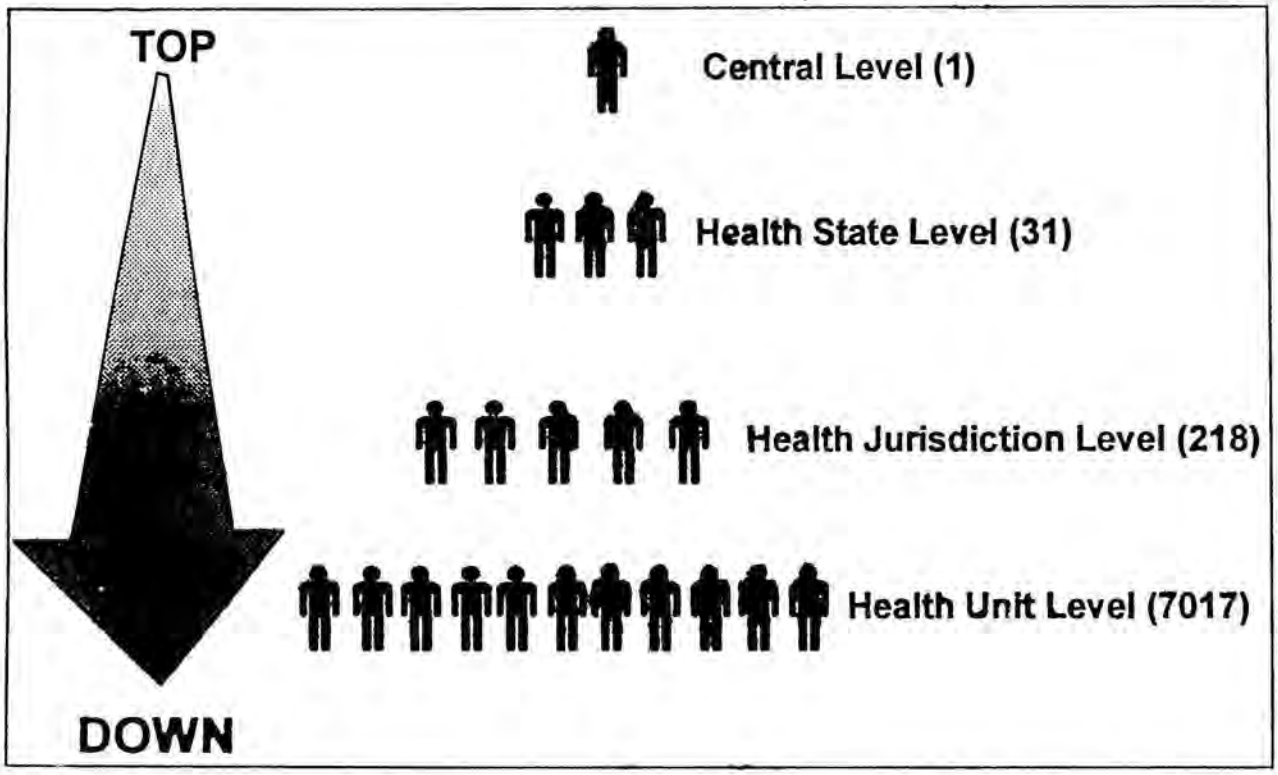

Figure 1: Implementation of SEIB activities at four levels (hierarchies) of development, illustrating a top-down approach (numbers in brackets identify the amount of units at each level)

5. The problem situation

The participating actors involved in the implementation of SEIB have complained about the functioning of the system from different perspectives. End-users for example do not seem to be convinced of the 'reliability' of the information system. Producers of information on the other hand have complained about the lack of 'consistency' in the collection and interpretation of data, and intermediaries lack training skills to run the system.

These different 'views' of the system, as seen by the different actors involved, integrate not a 'problem' as such but a 'problem situation' in which there are felt to be 'unstructured' problems. In this context, Checkland (1981) distinguishes two kinds of problems: (a) those which are 'structured', i.e. explicitly stated in a language which implies that a theory concerning their solution is available (for example, how to transport 'X' form 'Y' to 'Z' at minimum cost); and (b) 'unstructured' problems which are manifest in a feeling of unease but which cannot be explicitly stated without this appearing to oversimplify the situation (for example, what should we be doing to transform the SEIB into a 'reliable' information system). Clearly, problems are what 'hard' systems thinking and 'operations research' are concerned with. Unstructured problems on the other hand are to be approached through 'soft' systems methodologies.

6. Purpose of the work

The purpose of this work is to present the preliminary results of a system analysis carried out on Mexico's SEIB. The aim was to identify the different 'soft' elements involved in the above mentioned 'problem situation'. It was hoped that with the identification of those elements, a model and a 'rich picture' would be obtained so as to propose a 'plan of action' to understand and improve the existing situation.

7. The system analysis

The analysis of the system was limited to the review of the literature in the field, direct observation of SEIB procedures, and information collected from the comments provided by some of the users/producers of information. The academic discussions derived from the seminars with the MSc. students at the School of Public Health of Mexico also contributed to enrich the analysis.

The information obtained helped first to obtain a 'rich picture' of the situation. Following Checkland's approach (Checkland, 1981; Checkland & Scholes, 1990), the different 'views' of the actors were considered. After a process of iteration, a model describing the main elements affecting the situation was developed. Figure 2 illustrates how SEIB goals are not met due to the interaction of such elements.

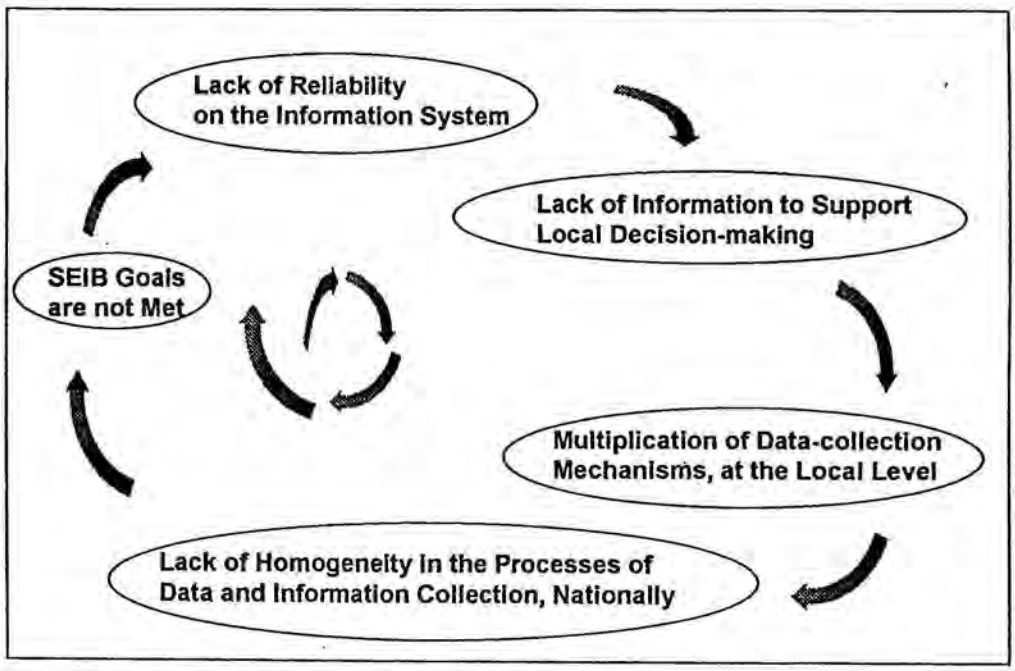

Figure 2: Model of the main elements that interact in the definition of a "problem situation" surrounding Mexico's SEIB

The different problems identified regarding the existing situation were classified according to the following three categories:

1 Problems involving the 'actors' of the system, such as users, producers and intermediaries in the organisation, and management of information or information processing procedures.

2 Problems involving the information sources/resources, including formats, publications, products, databases, etc.

3 Problems involving the 'environment' surrounding 1 and 2 above, such as the channels of communication between the users/producers of information and the information sources/resources, social, cultural or political factors.

Figure 3 illustrates a model of a 'rich picture' of the interaction of the above mentioned categories.

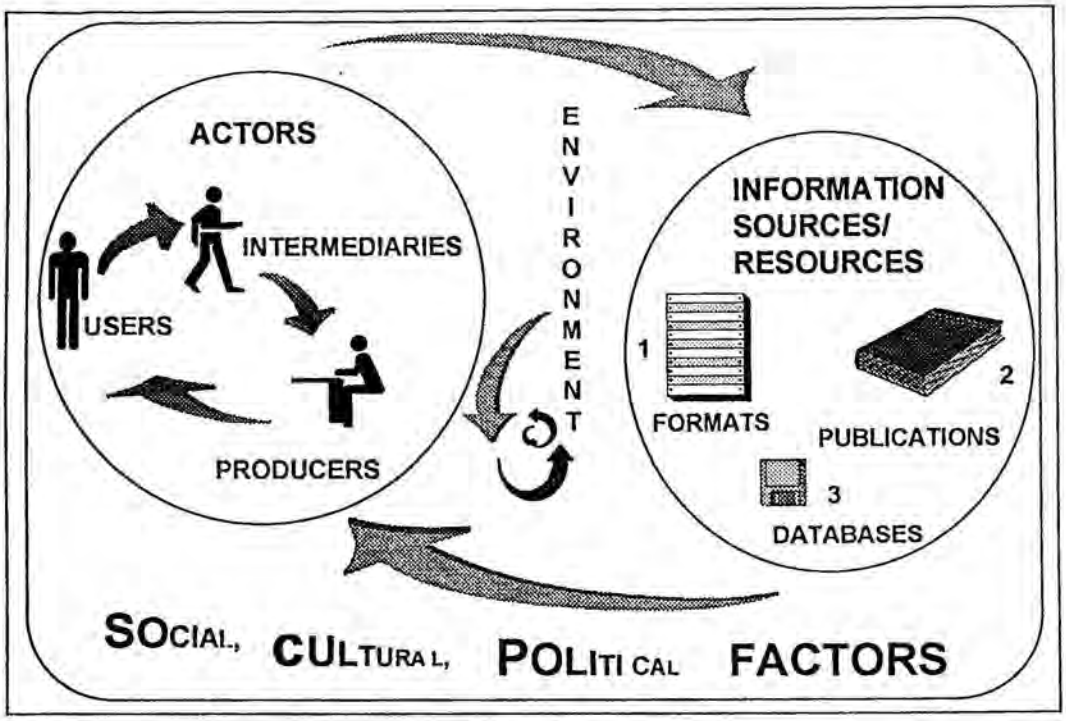

Figure 3: A model of a rich picture of the 'problem situation', identifying the actors, the information sources and the environment factors involved.

Over thirty problems were initially described. After a process of analysis, it was concluded that the main problems identified for each category could be summarized as follows:

Problems involving the 'actors'. These included the following:

1 Lack of training/capacitation/education. Users, producers and intermediaries of information sources were not adequately trained in the different procedures to collect, analyze and interpret data and information.

2 Lack of information 'culture'. It was perceived that 'actors' do not consistently use information for decision making and that 'value' was not being added to information, so as to use it as a resource.

3 Lack of information system's reliability. Since producers of information would 'handle' data at their own - local - convenience, they assume other actors would also alter their statistics. Thus, a consensus regarding the lack of 'trust' to use certain data was felt among the different actors.

4 Activities becoming tedious. The mandatory, top-down approach of the information system resulted in the implementation of systematic, tedious activities.

Problems involving the 'information sources/resources'. These included the following:

1 Excess (over-production) of data and information. Health jurisdictions were forced to produce statistical reports in an effort to satisfy 'centralised' information needs rather than local demands.

2 Lack of consistency/homogeneity in the collection and interpretation of data. While procedures were defined to collect data, they were not established nationally and homogenously. These resulted in varying ways to collect and interpret data.

3 Duplication/multiplication of formats/sources of information. Parallel mechanisms to satisfy local information needs were adopted by health jurisdictions. These resulted in duplication of formats, procedures and products.

Problems involving the 'environment'. These were the following:

1 Lack of need for the equipment. Computers were assigned without previous analysis of the existing - local - infrastructure. For example, they would be assigned to health jurisdictions that lacked electricity.

2 Bureaucracy. The implementation of the information system demanded the setting up of a 'statistics office' in each health jurisdiction. These resulted in the allocation of extra resources and the adoption of bureaucratic procedures to analyze and retrieve information.

3 Lack of time to fulfil goals. Formats were not filled out in time to be sent to the central office in Mexico City for their analysis. Same data, for instance, would be reported for two or three consecutive months.

4 Geographic barriers to collect and process data. Some health jurisdictions were isolated, lacking proper communication roads and links with other cities, making it difficult to fulfil goals in time.

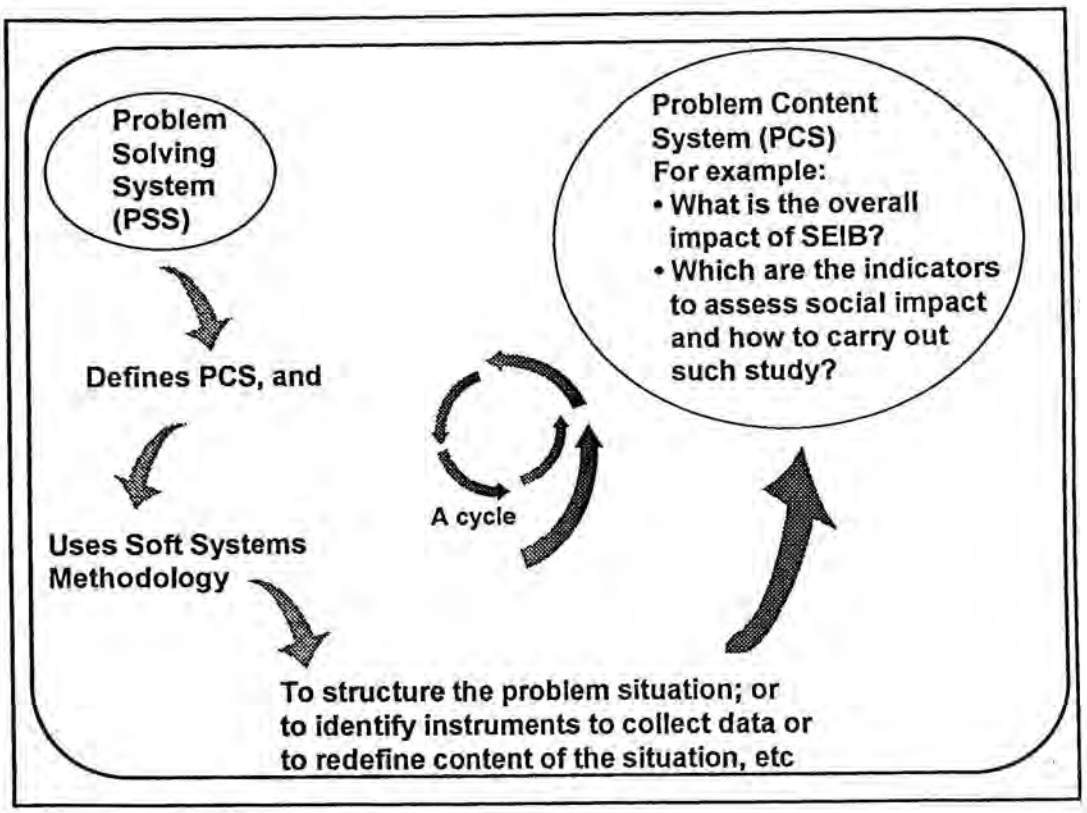

Figure 4: A model of a system to approach the problem contents of SEIB

5 Lack of 'feedback' from the 'central level'. Some health jurisdictions complained about the lack of feedback from the central office. This resulted in the lack of information to fulfil goals regarding health programmes, as demanded by SSA.

6 Lack of indicators to assess social impact. Since no 'feedback' existed from the central level, indicators to assess social impact at the local level could not be obtained. Local health status had to be assessed through other - local - means.

The 'structured' problem situation was defined and tackled as follows:

SEIB in Mexico has been implemented through a prescriptive, top-down approach; this has resulted in the emergence of barriers to adequately collect, process, access, use and generate information. Such barriers may be classified according to either the user/producer of information, the information sources/resources, or the environment. Should an improvement of this situation be required, these elements should be taken into consideration. The information flows should be bi-directional so as to access and use information to support the decision making activities at the different levels of the health care need-satisfaction processes. In this effort, a wholistic, soft systems approach needs to be used as a methodology to take into consideration the different views of the actors both, from the perspective of the problem-content-system and that of the problem-solving-system.

Figure 4, above, illustrates a model to approach the problem contents of SEIB through the use of soft systems methodology.

8. Discussion and conclusion

Health problems have not been solved by medicine, organisational management or politics alone but have yielded to a total systems science approach in which the clinical, institutional, cultural and social aspects are considered simultaneously. Adequate information is essential for the efficient operation of all health systems components, from top managerial level down to individual and operational levels. Information is needed for the planning and implementation of activities, for evaluating the efficiency of medical institutions, for determining to what degree the available services are used by the population, and for organising the day to day operations by physicians, allied health personnel and patients.

In this study, a framework of concern was identified at the operational level of SEIB. A consensus was obtained of a 'problem situation'. Such problems, however, could not be well defined by the different actors involved in the use of SEIB. Their concern was mainly focused on the 'operation' of the system; little thinking was given to the elements regarding the 'structure' and the 'processes/outcomes' of the information system. Through system analysis, a rich picture of the situation and a more 'structured' definition of the problem could be obtained.

SEIB started as an ambitious, nation-wide health information system. While highly structured in its organisation and goals, little attention was given to the socio-cultural aspects of both users and producers of information. Less attention was given to the 'environment', the community and to its social impact. The different views obtained from the varying actors involved in this analysis reflected the lack of consideration for 'soft' elements in the design and implementation of SEIB. This is not a surprising finding. In many instances, for example, no cognizance was taken of how a particular system will have repercussions in other functional areas within the organisation. It is these particular failures which are expensive to organisations in terms of time and resources. Very often the result is that information systems are technical successes but organisational failures.

On the other hand, system evaluation and review should be undertaken at regular intervals in order to ensure that the information system is not only performing well from a technical point of view but is providing the organisation with the relevant information for effective decision-making.

In the health/information science fields, such an issue constitutes an interesting area for research, for example, on how to approach information problems at the structure level of health care systems (Macías-Chapula, 1992); and on how to assess the impact of scientific and technical information on quality of health care (Macías-Chapula, 1994).

The use of soft systems methodologies to tackle information problems, and to analyze information systems in the health sciences, provides not only the opportunity to work with a multidisciplinary approach but also favours to cover the gap that exists between the hard and the soft sciences. This interaction has profound implications on both the health and the information sciences. If information systems are to succeed, an equilibrium of both hard and soft approaches to their development need to be taken into consideration.

From the analysis performed in this study, it is concluded that further in-depth research needs to be performed in order to analyze the 'defined problem situation' at different levels of resolution within the system. This will help to generate a plan of action to improve the existing situation. In this effort, soft systems methodology can be used as an approach. There is a recognition in this approach that organisations are complex and unclear.

The philosophy of soft systems methodologies lies in their attempt to understand the organisations holistically, analyzing the structure of organisations from many viewpoints. In this context, an information system can be considered as a two-way process of inquiry or knowledge generation in which a systems analyst with the help of a user attempts to develop an understanding of the situation prior to intervention. This understanding and intervention methodology connects two abstract entities which Checkland (1984) calls 'complementarity'. This means that a methodology transfers 'thinking' about the 'content of the situation' which is relevant to the 'content situation'. These entities are interconnected in an approach to improve unstructured problem situations.

In this study, soft systems methodology was helpful both to understand the problem situation and to structure the different soft elements that interact in the situation. The analysis provided a model to base further research on, at the different levels of resolution of SEIB. This can be performed through the analysis of the 'human activities' that interact at the levels of 'structure', 'process' and 'outcome' of the system.

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An information technology policy towards development in a developing country: The situation in South Africa

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Abstract
This paper explores how a developing country, in particular South Africa, could incorporate information technology in the development and upliftment of its people and societies through a definite information technology policy. Some of the issues surrounding development, the socio-economic implications and its relation to human needs, will be debated in relation to information technology. An information technology perspective of South Africa will also be given. Thereafter, an attempt will be made to show the need for an information technology policy to enhance and accelerate socio-economic development.

1. Introduction

Information technology is probably one of the most important factors driving the evolution of global competition. The accelerating pace of technological innovation is spawning new businesses, transforming old ones, and redefining the rules of competitive success. Little wonder, then, that the national debate about the competitiveness of a country's industry, and the government's role in improving it, is increasingly becoming a debate about technology policy.

Usually, this debate centres on the question of whether government can or should play an active role in stimulating commercial technological innovation. Proponents of technology policy argue that a society's capacity for sustained technological innovation is crucial to its economic well-being. If questions and arguments like these are made by developed and industrialised countries, all the more must developing countries pay attention to this, as the information gap is widening between them, and development is restricted as a result of this 'information poverty'.

Branscomb (1992) argues that the issue is not whether a country should have a technology policy, but what kind of government policies and programs will make sense in this new competitive environment. Developing countries must also become part of this competitive environment, just like the developed countries that have already been part of it for some time. The end result should be an information technology policy that will link all the development parameters with the advantages of information technology in an applicable and appropriate information technology strategy for a developing country.

This paper will attempt to show how a developing country, in particular South Africa, could incorporate information technology in the development and upliftment of its people and societies through a definite information technology policy.

The paper is divided into seven parts. Part one covers background information on needs and development. The next part gives a perspective of the information technology (IT) situation in South Africa. The third part explores the important aspects of an IT policy, followed by a discussion on the Reconstruction and Development Programme (RDP) with an emphasis on technology. The fifth part discusses how an IT policy could be implemented within the RDP, and what problems, if any, could occur implementing such a policy. The sixth part provides reasons why an IT policy is necessary in a developing country, with the conclusion in the final part.

2. Needs and development

Development, most simply, is improvement in human well-being. Most people today aspire to higher standards of living, longer lives, and fewer health problems; education for themselves and their children that will increase their earning capacity and leave them more in control of their lives; a measure of stability and tranquillity; and the

opportunity to do the things that give them pleasure and satisfaction (Harrison, 1985).

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 moves away from a condition of life widely perceived as unsatisfactory, towards a situation or condition of life regarded as materially and spiritually 'better'.

Todaro (1989), Maslow (1968) and Max-Neef et al., (1989) indicate how development and needs interact with one another: Todaro emphasised that there are at least three basic components or core values that should serve as a conceptual basis and practical guideline for understanding the 'inner' meaning of development. They relate to fundamental human needs that find their expression in almost all societies and cultures at all times. These core values are:

1 life-sustenance: the ability to provide basic needs;
2 self-esteem: to be a person; and
3 freedom of servitude: to be able to choose.

Maslow proposed in a similar way a hierarchy of needs, which extend from physiological needs (for food, water, sleep) to safety needs (for security from harm) to need for love and affection to need for esteem (for both self-respect and status with others) to the highest level in the hierarchy, which Maslow calls "*the need for self-actualization*" (the need to fulfil one's highest personal potentialities).

Max-Neef et al., organised human needs into two main categories: existential and axiological. Existential needs are being, having, doing and interacting while axiological needs are subsistence, protection, affection, understanding, participation, idleness, creation, identity and freedom.

From these classifications it follows that food and shelter are not needs but satisfiers of the need for subsistence; while education, studying and investigation are satisfiers of the need for understanding. There is no one-to-one correspondence between needs and satisfiers.

If information is needed to enhance development, the ability to access and utilise the information will satisfy this need and information technology, as the enabler, will make it possible to provide the necessary information.

The question that now needs to be addressed is how information technology can help or contribute towards achieving these 'prerequisites' for development. It is important to clearly identify the actual need, what is required, at what level, how pervasive this need is, and whether it will meet all of the development priorities. Soupizet (quoted in Gardner, 1994) says:

> *Computers don't clothe, don't cure, don't feed. Their power begins and ends with information. Their usefulness is therefore strictly linked to the effectiveness of the information....*

It is true that computers cannot feed the six to nine thousand street children in South Africa, or provide the five million homes that are needed, but it can provide information on the locations of the street children, or provide demographic information on the locations where there is the biggest need for housing and which areas are the best suited for a housing project.

The following is an example of how information technology can play a supportive, sometimes crucial, role in the health care area. Doctors in a twenty six bed rural hospital in New York State discovered a heart murmur in a newborn child. As is typically the case in rural areas, there were no specialists on hand to examine the baby quickly. But through an innovative video conferencing network set up for demonstration purposes, a paediatric cardiologist in Buffalo, the nearest major city, was able to view the newborn's echocardiogram on a television monitor and assist in the diagnosis. Doctors and administrators want the demonstration to turn into a permanent set-up, linking the Buffalo area network with hospitals in rural New York (Du Preez, 1994).

Although this is an example of an IT application in a developed country, the same could be applied in a developing country where the rural areas are usually underdeveloped. It is clear that tremendous resources in the form of funds, infrastructure and manpower are needed to establish this kind of technology, which are normally difficult to obtain in a less developed country. For this reason an information technology policy is needed to decide on the allocation and necessity of limited resources.

Development is therefore both a physical reality and a state of mind in which society has, through some combination of social, economic, and institutional processes, secured the means for obtaining a better life. It is therefore essential to establish a definite and concrete information technology policy to ensure that information

technology is utilised to its potential, and to be able to achieve and enhance all the development attributes.

3. An information technology perspective of South Africa

"*Power is not money in the hands of few, but information in the hands of many*" (anonymous).

If one look at the three waves that are sweeping the world (Toffler, 1980), it becomes evident that all three structures exist in South Africa. The result is three different civilizations, and the question is what kind of system must be used to increase wealth? What is actually happening in the world today, is the emergence of economies that are neither agrarian (first wave) or industrial (second wave), but in fact are knowledge-based 'third-wave' societies. The real power in the future will lie with whoever controls the knowledge. The question for South Africa is how does it fit into this tri-sectored world - especially if it is tri-sectored internally - and what is going to be the dominant pathway to take? For this reason an applicable information technology policy is needed. South Africa must decide what kind of society it wants, and what role an IT policy will play in this regard. If the decision is to develop the third wave, then ways must be found to use third-wave technologies (information technology) to improve agriculture and health, or to extend the manufacturing of the second wave, through such a policy.

Can South Africa survive if the third-wave path of information technology is chosen? The answer is "yes". For this to happen, the playing fields must be levelled, as three-quarters of the South African population has been under-utilised (Mabuza-Suttle, 1994). South Africa cannot be effective in business without people; every aspect of business involves people. Max-Neef et al., (1989) believe that "*development is about people and not about objects*". Information technology should therefore be people-focused. An Afrocentric managerial style needs to be followed - a communal decision-making process, as opposed to a Eurocentric style of management, which is an I/me decision-making process.

Mr Nelson Mandela, President of South Africa, has emphasized that a 'people centred government' will be applied. Since an African culture is prevalent in South Africa, an 'ubuntu' approach must be followed. 'Ubuntu' is an African word which means 'warmth of the people of Africa' - with an emphasis on the community (a communal approach). The question is how 'ubuntu' or humaneness could be brought into information technology so that is doesn't appear as a 'white man's' technology.

In this regard is it important that the benefits and impact of information technology on the society should be visible. The people must see how information technology improves service and creates new jobs, industries and opportunities. To accept this 'new wave', the society must be encouraged to use it more often, so that they can get used to it. South Africa does not need a chaotic change (a real future shock) but a change that could be embraced, rather than running away from it. If information technology could be adapted to the skills level of unskilled workers and members of society, thereby pulling rather than pushing them into the information age, it will be so much more rewarding and socially responsible (Du Plooy & Roode, 1993). J.F. Kennedy, former president of the USA, made the remark:

> *Wealth is the means and people are the ends - with all the materials available, wealth will avail us little if we didn't use them to expand the opportunity of people.*

The people must be the focus point in the incorporation of information technology in the diversified societies of South Africa.

To ensure the successful utilisation of IT, the local culture must be taken into account, and the design of IT should not be divorced from the social environment. IT can be inappropriately introduced and used if the concepts and methodologies used are not adapted to the local environment (Moussa & Schware, quoted in Gardner, 1994).

The world does not owe South Africa 'anything'. It is not for the world to slow down to wait for South Africa, it is for South Africa to run fast enough to catch up. Therefore, a developing country like South Africa must learn how to exploit the technology at its best to address the deficiencies which bedevil its economic performance. Leapfrogging could be applied if necessary. Technology should be applied as much as possible to improve education or health, for instance. The world is moving towards science and technology. There is nothing else anyone can do about it.

> *In other words, don't run - get a bicycle, or, better still, an Italian sports car. It's quicker.* (Viedge, 1994)

The society must accept that, in order to keep abreast with the rest of the world, they will have to be retrained again and again. There is no substitute - it is the only way to survive. Developing countries need to get

on the learning curve as quickly as possible so that they do not miss this 'third wave revolution'. Technology is the partner of any developing country in its quest for international competitiveness.

4. An information technology policy for South Africa

Should a developing country like South Africa have a definite IT policy so that the advantages (or disadvantages) of information technology could be realised?

Any secure building, how big or small it may be, requires a well laid foundation before being utilised. The same applies to the consideration, utilisation and acquisition of IT in a developing country. This foundation could be established through an information technology policy. Consideration firstly needs to be made of the presence (or absence) of a national plan or strategy for IT utilisation and development within the country. The absence of such a document can be a warning sign for one to conduct further investigation into any future plans regarding information technology in the country. Unclear priorities and objectives at a national level can obviously influence the success, or otherwise, of any IT project. One example could be the varying response to the importation of expensive equipment, upon which the success of the project may rest.

National policies are usually directly or indirectly related to social, economic and political conditions in a country, and the public sector can influence the use of IT by either approving of the technology and then investing in the necessary infrastructure, or disapproving and enforcing restrictions on its importation and use. The emerging role for government agencies is one of supporting decentralized activities, private sector development, and non-governmental organizations and of creating an enabling environment for flexible supply to response (Hanna, 1991).

It makes sense to argue that in an underdeveloped or developing country the government should play a major role as the enabler and facilitator of IT, rather than the private sector. The public sector can facilitate the growth and establishment of an entrepreneurial culture by its policies and openness. A secure, stable government with an efficient public service may sound utopian but may be an essential foundation required to ensure successful IT utilisation (Odedra, quoted in Gardner, 1994).

The following section discusses an information technology policy as a foundation whereby the great potential of IT can be realised, development be promoted, technology fully be exploited, and some of the common problems in the developing countries be alleviated.

4.1 Main aspects of an information technology policy

Before a scholar can use a computer in the class room, electricity should be available. For the school or education department to be able to purchase computer equipment, funds must be available. Skilled manpower must be available to teach and maintain the computer technology. What this all leads to, is some form of draft, document, strategy or program that can be used to manage and apply these limited resources which are crucial for the effective utilisation of information technology. The following are essential factors that should be considered when formulating such an information technology policy, and to ensure the 'correct' environment for information technology to be utilised to its full potential within a developing culture.

4.1.1 Infrastructure

Telecommunications in developed countries is often taken for granted. However, the situation in the developing countries can be very different. Building an information system on a foundation of a telecommunications infrastructure which is either nonexistent or of poor quality will obviously result in subsequent poor utilisation of the IT. MacKenzie (1994) remarked that while many businessmen and industries talk of Africa as a vast, untapped market, unless its telecommunications infrastructure is significantly improved, it will remain just that - an untapped market.

Telkom, the major telecommunications organisation in South Africa, is looking for foreign partners to help fund its provision of telecommunications services in underdeveloped regions. The organisation expects to spend around 1,2 billion Rand a year for the next five years, providing telecommunications services to previously neglected regions as part of the government's Reconstruction and Development Programme. According to Alan Knott-Craig (1994), CEO of Vodacom, cellular technology has a big role to play in getting basic communications to as many people as possible in the shortest space of time. Users can plug PCs directly into the telephones and communicate with any on-line database anywhere in the world. The implementation of a telephone infrastructure

not only increases the effectiveness of business, but helps to directly create jobs as well. According to Knott-Craig, each cellular operator will create 4,500 jobs directly, with a further 40,000 jobs created indirectly.

The private sector, with the backing and approval of the government, can therefore make it possible for IT to be implemented and utilised in rural regions where development is a necessity through a telecommunications infrastructure.

Similarly, there is the need to investigate the state of the road and the electricity supply networks. Unreliable electric power supply can create serious problems for IT usage and operations. Should the IT project require the need for delivery of large equipment then the condition of the roads is important.

4.1.2 Human resources

The availability and quality of human resources is a very important (if not the most important) foundation for the successful implementation of information technology in a developing country. One of the biggest problems South Africa faces is the over-supply of unskilled labour. For information technology to be adequately utilised skilled people such as information systems personnel, technical support and maintenance staff, educators, etc., are needed to develop and establish information technology. Through an information technology policy guidelines can be formulated on how to fill the human resource gap.

An information technology policy must also make provision for vendors and suppliers of IT not to manipulate management and decision makers into buying their equipment, which often happens in developing countries. Their main concern often appears to be selling obsolete and incompatible technology at inflated prices and not in the appropriate transfer of technology (Odedra, quoted in Gardner, 1994).

The availability of education and training facilities for end users is also vital and can have a direct relation to the subsequent successful utilisation of information technology (Gardner, 1994). According to Lu and Farrell (1990), if the education in computer literacy is poor, the consequence is that the majority of end-users are computer illiterate. This often leads to over-optimism about computer capabilities. IT policies should address the rigidity of current educational systems and support the most promising channels for the transfer of 'know-how' and best practises. In Korea, Taiwan and Singapore, these policies also include training of IT users in the civil service and private sectors (Hanna, 1991).

Countries such as the United Kingdom, France, Italy and Japan have nationwide computer-literacy policies (Hanna, op. cit.). In Singapore, computer literacy and informatics education are integral parts of a national strategy for developing the infrastructure to make Singapore a regional center for informatics-based services. According to the Toronto Globe and Mail (Viehland, 1994), New Brunswick, Canada, plans to make computer literacy a core subject required for high school graduation in the hope of reducing unemployment. South Africa could also do the same, provided the necessary resources are available.

4.1.3 Defining needs and priorities

"*One must ensure that the need is met, and not make the need meet the technology*" (Gardner, 1994). The need for information technology must be clearly identified and well-defined. Clearly identifying the need for any IT, and then ensuring that it is driven by the owner of that need, will cause the responsibility for the subsequent successful utilisation of IT to rest where it should - with the final user of the IT. For example, if the school system needs computers to be able to make scholars computer literate, this need must be expressed explicitly. In other words, a real motivated need must exist. There are numerous cases of companies and government agencies that donate new or obsolete equipment to organisations or communities only for the equipment to be stored away and never used, due partly to the fact that there was no perceived need for IT in the first place.

Developing countries must select priority sectors or areas for the application of information technology. Infrastructural requirements must be identified and concrete informatics strategies and plans must be prepared to support priorities and to monitor progress. Applications of information technology should be driven by needs and national priorities, not by the technologies, no matter how dazzling those technologies may be.

Branscomb (1992) proposed a 'critical technologies' list which purports to describe those technologies crucial for future economic and social well-being and to serve as a guide for government investment. 'Critical technologies' list exemplifies what is wrong with the technology policy debate. A detailed evaluation of strengths and weaknesses in relation to information technology should be conducted.

4.1.4 Financial resources

The acquisition of most IT is expensive. MacKenzie (1994) observed that:

> *...you cannot have an economy without a reliable, up-to-speed telecommunications infrastructure, and you cannot afford to implement a workable telecommunications infrastructure without an effective economy. In short, a proper telecommunications infrastructure costs money, and that is one thing not in good supply in most African countries.*

Consideration must be given not only to the current availability of financial resources but also to the ongoing nature of the financial resources. The lack of foreign exchange within most developing countries and poor exchange rates are matters of concern. Companies, foreign and local, can be encouraged to invest in IT for the purpose of development by means of incentives such as tax deductions. A company that donates IT equipment to rural schools, or assist with the education and training of underprivileged people in the use of IT, could be given tax advantages or some other kind of rebate, subsidy or recognition. Organisations such as the International Monetary Fund (IMF) and World Bank could also assist with financial aid to countries and companies investing in IT for development purposes in developing countries.

4.1.5 Access to information technology

The IT policy must make provision for the ability to obtain technology and supplies, and also for the access to international knowledge flows regarding information technology. This access is vital in ensuring that the IT to be used is not obsolete and that there is the flexibility to change and upgrade depending on the requirements and needs. This access will not only lead to an awareness of the latest trends but will assist in the awareness of information and IT.

What is important is that access to information should be equitable. Shaping IT policies in support of growth with equity requires an understanding of the role of information in the primary economic activities among the rural poor and the role of information technology in meeting the learning and communication needs of the rural populations. Without appropriate policies and programs, information technology may reinforce social and economic dualism, widening the gap between the urban and rural areas and between the rich and poor. The poor suffer the most from information poverty, as both producers and consumers. This dualism will remain, or even be reinforced, unless there is greater recognition of, and public support for, the vast needs of the rural population for learning and information exchange (Hanna, 1991).

South Africa must devise policies and strategies to apply information technology for the upliftment of the poor and rural populations. For example, information technology could assist in providing social services to inaccessible areas. Information technology could also be used to broaden public access to information resources and empower the disadvantaged, the non-governmental organisations, and the rural population through timely and relevant information on resources and opportunities.

4.1.6 Innovation

Branscomb (1992) holds the view that simply creating new technologies and funding basic research in universities are no longer good enough. Instead of concentrating on the 'supply' of new information technologies, government should stimulate 'demand' for innovative ideas by helping companies across the industrial spectrum speed up the commercialization of good ideas to meet specific development needs. This can be done by encouraging collaborative research among companies and between industry, universities, and government institutions; by investing in the technological infrastructure on which all innovation is based, and by helping develop the tools and techniques that society needs to be more productive.

4.1.7 International policy issues

Public policy must address issues arising from the global transfer of information and information technology and from trading in information-based services, which increases the need for international and regional cooperation. One example is the transfer of information across national boundaries through global communication links.

Many developing countries are concerned about the possible effect of information technology on the control of their own social and economic development. But at the same time, developing countries are dependent on a free flow of information to provide them with access to research findings and technological information. International

cooperation may help redress the imbalances in the world's flow of information through practical assistance and local communication capability building, while at the same time safeguarding the fundamental principles of freedom of information and communication (Hanna, 1991). International agencies are called upon to assist developing countries in articulating their interests and concerns in various international forums, to accelerate the learning process, and to facilitate international cooperation and negotiation.

4.2 Conclusion

It is therefore important that the creation and expansion of an IT infrastructure, both physical and institutional, be available to all the people in South Africa. Strict standards related to the quality of IT products should be enforced. Educational and training programmes should be set up to develop awareness of the potential of IT and to provide basic computer literacy. This all leads to the main objective: to support the national priorities of the country as set out in the Reconstruction and Development Programme by means of a national IT policy.

5. The reconstruction and development programme (RDP)

According to the African National Congress (ANC, 1994), the development of an information network should play a crucial role in facilitating the provision of high-quality services to all the people of South-Africa. It must provide a significant advantage to the business sector as it reduces costs and increases productivity, and serves as an integral part of financial services, the commodities market, trade and manufacturing. The basic infrastructural network must remain within the public sector. Certain value-added services could be licensed within the framework of an overall telecommunications programme.

The RDP aims to bring telecommunications closer to all potential users. A telecommunications regulatory authority must be established which should be separated from policy and operating activities. The development of telecommunications must be underpinned by a strong telecommunications manufacturing sector. The government must encourage this sector to work closely with the network operators in developing suitable systems for possible export to Africa and other developing areas.

The objective of the RDP's technology policy is to establish an integrated programme, based on the people, which builds the nation and links reconstruction and development.

The following is a summary of the basic science and technology policy of the RDP for South Africa, as was proposed by the ANC (1994):

1. Technology policy is a key component in both industrial strategy and high-quality social and economic infrastructure. It is critical for raising productivity in both small- and large-scale enterprises.
2. Science and technology policy should pursue the broad objectives of developing a supportive environment for innovation; reversing the decline in resources for formal science and technology efforts in both the private and public sectors; enabling appropriate sectors of the economy to compete internationally; ensuring that scientific advances translate more effectively into technological applications, including in the small and micro sector and in rural development; and humanising technology to minimise the effect on working conditions and employment.
3. Technology policy must support inter-firm linkages that facilitate innovation. In research and development, the government should support precompetitive collaboration between local firms and public-domain efforts combining enterprises and scientific institutes.
4. Incentives should support expansion in technological capacity in both existing firms and new start-ups.
5. The Ministry of Education must establish targets in the study of technology in educational institutions it subsidises. Research in the technology arena by the government, parastatals and educational institutions must cater equally to the needs of women in this area.
6. New legislation must ensure that agreements to import foreign technology include a commitment to educate and train local labour to use, maintain and extend technology. Appropriate technology for small and medium-sized enterprises must be purchased where necessary and applicable from other developing countries.
7. The government must develop programmes to make university-based technology more responsive to the needs of the majority of South Africa's people for basic infrastructure, goods and service. Scientific research should link up with technological advance in industry, commerce and services and in small and

micro production. In particular, there must be research into appropriate and sustainable technologies for the rural areas.

These policy statements make it clear that South Africa wants to incorporate all of its people in the utilisation of technology, and then specific information technology. The government realises that "*people make things happen - people make IT happen*". The American philosopher Michael Novak once said: "*The true source of a wealthy nation lies in human creativity*". By means of an appropriate information technology policy the people of South Africa should be allowed to apply creativity and innovation in the utilisation of IT to fulfil and realise socio-economic development.

6. Implementing an information technology policy within the RDP

When implementing any policy problems and questions usually arise about the necessity, applicability and feasibility of the policy. The ANC (1994) has already committed itself to the development of an IT network that will provide high-quality service to all the people in South Africa. Technology is therefore an important and integral part of the RDP and the future development and upliftment of all people.

However, at this stage where South Africa finds itself in a transformation phase with the emphasis on the improvement of living standards, the top priority that needs attention is the meeting of basic needs (the first hierarchy level proposed by Maslow) such as nutrition, health care and housing. Aid from other countries is also directed at these needs.

This implies that an IT policy will not necessarily be implemented immediately because of other high-priority issues. This does not mean that such a policy should not be formulated at this stage. On the contrary, it can only be to the advantage because by the time it becomes appropriate, it will already be well-defined and refined. What is of the utmost importance is that the government should not wait too long, otherwise the 'information gap' will widen more and more.

The IT policy should also be formulated and implemented within the framework of the national policies as proposed in the RDP. If a closer look is taken at the objectives of the RDP (as was described in section five), an IT policy should be defined accordingly:

Establish an integrated programme: The IT policy should bring together strategies to harness all the available resources in a coherent and purposeful effort that can be sustained into the future. All parts and levels of the economy and society should be incorporated, not only parts of it. All the people and role players should be involved and integrated in formulating an IT policy because it is a people-driven process.

Based on people: People are the most important resource because people utilise information technology. Without people there will not be any need for information technology. The IT policy should present IT as people's technology (the ubuntu approach) and not as something unusual or 'out there'.

Which builds the nation: All three waves that were described by Toffler (1980) exist in South Africa. By means of an IT policy the first two waves could be developed to result in a knowledge-based and information-centred society. Knowledge empowers a nation and it closes the information gap.

Links reconstruction and development: Reconstruction and development are parts of an integrated process. This is in contrast to a commonly held view that growth and development contradict each other and that growth must precede development. Information technology can assist in meeting the basic needs and an IT policy must ensure that this actually happens.

7. Reasons for an information technology policy

Any policy should be defined with some specific reason in mind. The following are some reasons why it is necessary to define and formulate a definite information technology policy:

1 To understand why information technology is needed. If their is no real need for IT, it will not be necessary to define an IT policy.

2 To have a basis to work from. A framework must be constructed to give direction and guide the policy makers, and everyone involved, with the why's, where's and when's of IT utilisation.

3 To have a clear mission for the future with regards to information technology. Without a mission it will be difficult to define objectives that should be reached.

4 To ensure that all role players, i.e. government, industry and the society, are identified and that each one

knows its responsibility and function in relation to IT utilisation and application.

5 To ensure that funds, aid and donations received for the implementation of IT services are allocated properly and that no illegalities occur during the allocation of funds received from contributors. Countries or institutions contributing funds or aid to South Africa should be shown that information technology will be applied in a structured and well-organized manner because of a national policy. Because an IT policy will necessarily address all the important aspects of IT, contributors will know beforehand the 'environment' within which IT will be applied.

6 To ensure that information technology is diffused effectively. According to Hanna (1991), many developing countries have adopted a supply-oriented informatics policy. Few have defined policies in support of the wider interests of IT users throughout the economy. IT policies should firstly give priority to the effective diffusion of IT in support of the whole economy. Experience so far suggests that a too-restrictive import policy in the IT industries can have a positive effect on the country's technological autonomy, but a negative effect on its industrial infrastructure and on the diffusion of this valuable technology to the rest of the economy.

7 To ensure that the infrastructure and environment, where information technology should be applied, are sufficient and effective. For example, it makes no sense to donate or buy computers for a school if there is no electrical supply or no teachers available to teach computer applications.

8 To assist with the legality of information technology acquisition and application. Legal aspects related to information technology, for example, copyright of software, importation of IT equipment, tax considerations, etc., should be clarified in a policy.

9 To support the RDP. The IT policy should be defined to further the RDP's goals and objectives. Because the RDP is an integrated, coherent, socio-economic, policy framework, whereupon the transformation of South Africa is based, an IT policy should go hand in hand with it.

Without a policy, there will be no direction, and without a direction, there will be no information technology.

8. Conclusion

Harrison (1985) makes the following remarks with respect to development:

> *I believe that the creative capacity of human beings is at the heart of the development process. What makes development happen is our ability to imagine, theorize, conceptualize, experiment, invent, articulate, organize, manage, solve problems, and do a hundred others things with our minds and hands that contribute to the progress of the individual and of humankind. Natural resources, climate, geography, history, market size, governmental policies, and many other factors influence the direction and pace of progress. But the engine is human creative capacity.*

This paper examined the use of an information technology policy to structure, organise, facilitate and implement information technology in a developing country, in particular South Africa. Basic needs and priorities should first be defined in order to establish the direction and contents of the policy. It makes no sense formulating a policy if there is no definite need for certain aspects of IT utilisation. It is also impossible to consider an IT policy without placing it in its proper place in a national development framework. The key role players, i.e. the government, public and private sector, education and training institutions, development and international aid agencies, should all work together in formulating such a policy, as each one plays a crucial role in carrying it into effect: the government as the enabler and industry as the doer.

From the book "*Teaching the Elephants to Dance*" (author unknown), the following passage is quoted:

It starts with a spark; an idea; a vision;
it takes people, a lot of people;
people who have to be convinced;
people who have to be empowered to take
responsibility and contribute fresh inspiration;
it takes commitment and selfless leadership.

It starts with a spark; an idea; a vision;

To have a clear vision of the future, where IT is part of that future, is already a starting-point in the right direction. Government, as the enabler, should work together with industry to 'light the torch' of information technology.

it takes people, a lot of people;

All the communities of South Africa - rural and urban - should have equal access to information technology, and all people should be taken into account in the formulation of an IT policy.

people who have to be convinced;

The advantages and usefulness of information technology should be visible to all people so that the effect of IT could be realised. The ubuntu approach to information technology where IT is presented as a humane technology should be applied in order to convince the people.

people who have to be empowered to take
responsibility and contribute fresh inspiration;

A basic computer literacy level is generally expected in the world today. Through knowledge and information the people of South Africa will become empowered and the information gap and information poverty will narrow.

it takes commitment and selfless leadership.

Commitment is needed from government, public and private sectors, to make IT work, but also from the people and societies to utilise IT, learn IT skills and use IT to develop themselves. Government, in cooperation with industry, should take the leadership to introduce information technology in all spheres of the South African society within the framework of a definite information technology policy.

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The Indian information technology industry: Adapting to globalisation and policy change in the 1990s

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Abstract
India's information technology (IT) industry has experienced a variety of state policy interventions from the 1970s until today. The protectionist policies of the seventies and early eighties have given way to liberalisation and globalisation in the 1990s. The impact of globalisation may at once be both positive and negative; it provides a pathway to continuous technological upgrading, but at the same time threatens the very survival of indigenous IT firms and their technological capabilities, painstakingly built on the basis of import substitution. The paper analyses important changes and identifies the latest trends in the Indian IT industry as it faces up to the challenge posed by policy liberalisation and globalisation. While Indian IT firms are remarkably adapting and responding to the changed economic and policy environment of the 1990s, the industry's future can only be secured by a renewed policy thrust on applications development for the domestic market accompanied by a push for IT diffusion as against mere production. While the paper cautions against generalised policy prescriptions, it illustrates the significance of pragmatic policies for less industrialised or developing economies to maximise the benefits from IT while coping with the rapid technological changes that characterise the industry.

1. Introduction

Over the past decade, there has been growing interest in the nature, scope and impact of state policy to stimulate economic development through more rapid technological advances and expansion of productive capabilities for both domestic and foreign markets (Brown & Rushing, 1986). The focus in more recent years has increasingly been on high technology industries such as information technology (IT), characterised by product complexity and rapidity of technological change. In many countries throughout the world, the East Asian newly industrialised economies being only the latest examples, IT is being seen as a driving force in economic development and state policy as the means to explicitly facilitate its use and production (see Harindranath & Liebenau, 1993).

The rationale behind the deliberate promotion of an IT industry in countries like India immediately draws into question the domestic capability of developing economies to exploit international technological developments and harness them for their economic development. Different schools of thought within the realm of development studies, and particularly within studies of high technology based industrialisation, continue to treat this as a contentious issue. For instance, while the dependency school sees less developed economies as being permanently entwined in relations of dependency with the economically and technologically advanced countries, the bargaining school contends that international technological change tends to constrain the range of choice for less industrialised countries in their relations with the international system. Therefore, their adaptive capabilities in high technology areas are severely limited (see Grieco, 1984). However, the development strategies of many Asian countries, and particularly their experiences with IT, have necessitated a rethinking on these widely prevalent and generalised assumptions about the so called developing or Third World as a whole. Therefore, an adequate understanding of historical and economic processes calls for a rigorous analysis of specific cases (Nayar, 1983).

This paper is not merely meant to be a contribution towards this end. The paper analyses important changes that are taking place in the Indian IT industry in the 1990s, as a result of liberalisation of state policy and the accompanying process of globalisation. The paper does so by examining the manner in which the Indian IT industry is adapting and responding to policy change. While the phenomena of liberalisation and globalisation present immense opportunities in terms of access to the latest technology, they also pose grave threats to the survival of local IT firms, and hence India's technological capabilities in IT. Furthermore, the process of globalisation of the

Indian IT industry exemplifies an urgent need to make hard choices with regard to the age-old, but all important debate on IT use versus IT production. Lessons from the Indian experience will prove to be of significance for IT policy and IT industries in other industrialising economies, thus helping to provide useful insights into how these countries can maximise the benefits from IT while coping with the rapid technological changes that are characteristic of this industry.

The Indian approach to the development of the IT industry has passed through an entire gamut of policy variations, from dependence on multinational corporations (MNCs) in the 1960s and early 1970s, to import substitution during the late 1970s and early 1980s (Grieco, 1984; Mahalingam, 1989; Subramanian, 1992), and from a cautious and gradual policy liberalisation in the mid-eighties to rapid liberalisation and attempts at globalisation during the 1990s. Moreover, India's policy experience in the IT industry is representative of a more global shift in development policy thinking from state intervention towards market oriented policies. However, the paper does not advocate an 'Indian model' or alternative to the development of an IT industry. Indeed, any such model for policy guidance can be simplistic and even deceptive, as what often come to be retrospectively termed 'models' are the result of growth trajectories that have tried and tested several policies, and learned from their experience, including learning from mistakes. Viewed from this perspective, the paper also constitutes a contribution to the limited but growing literature that seeks to disaggregate the so called Third World into heterogenous units at different economic levels of development, with a wide variety of policy experiences and specificties.

Before proceeding to examine the impact of globalisation on the Indian IT industry, a brief consideration of the concepts of state policy liberalisation and globalisation is in order.

2. Liberalisation and globalisation

Liberalisation is the key policy prescription originating from the neo-liberal thinking on development. In its milder form, neo-liberals recognise the possibility of market failures, but consider imperfect markets to be better than imperfect states. Therefore, they argue against any form of state intervention in the economic affairs of a country. In contrast, structuralist thinkers invariably prescribe some form of state intervention, though they do not altogether preclude the role of the market in economic development. Liberalisation, then, can be conceptualised as a move away from the structuralist extreme towards more market oriented economic policies (Colclough, 1991; Heeks, 1991, pp.5-10).

Globalisation may be seen as an outcome of liberalisation. However, while certain types of liberalisation may merely imply limited deregulation and privatisation, the process of globalisation goes far beyond both, and involves an active attempt at becoming a part of the global economy. By its very nature, globalisation involves as an imperative the need to take the international market into serious consideration while making any investment decision in an economy or sector (Sen, 1992). This implies that investment and production will aim at achieving international levels of quality and cost, so that local producers have the option to export when there is slack domestic demand. Thus, successful globalisation invariably requires "*an active interaction with industrialised societies and MNCs*" (Prahalad, 1993).

3. Globalising the Indian IT industry

The attempt to globalise the Indian IT industry in the 1990s has been a direct consequence of the macro economic problems faced by the country in 1991. For a holistic understanding of the changes in state policy for the IT industry, we need to put this industry in a macroeconomic perspective and against the backdrop of India's changing policy trajectory over the decades.

The post-independence policy regime in India gave primary importance to self reliance, and as a result attempted to produce all that, in principle, the country was capable of producing. Static comparative advantages were discarded for the creation of dynamic ones, especially in high technology areas. As with the rest of the economy, the computer hardware manufacturing industry was also subjected to import substitution until the mid-1980s, while software related policies have traditionally been export oriented and hence less protectionist. A system of industrial licensing was established to regulate not merely the entry of firms, but also their expansion, diversification and even their exit from the industry. Policy measures were also put in place to encourage the regional dispersion of industrial growth, and specifically to protect small scale enterprises. This in turn encouraged firms to set up sub-optimal scales of production. Along with this, a system of import licensing and abnormally high

customs tariffs protected the domestic industry from foreign competition. This guaranteed good profit margins despite the low production volumes. Further, high tariffs on the import of complete systems provided sufficient incentive for local manufacturing even though the actual import content of such systems were very high. While this was aimed at building domestic technological capabilities, it also provided across-the-board protection to even inefficient firms that operated with no concern for relative costs of domestic and foreign production, or even quality.

These policies resulted in a woefully inefficient, high cost industrial structure in general[1], and a large number of inefficient assemblers in the computer industry who added no value to the products they claimed to manufacture within the country. Further, these firms needed continued sheltering from foreign competition for their very survival. Thus India's import substituting industrial strategy soon became the country's developmental bane, as it transformed itself into a bureaucratic maze of controls and regulation, red tape and inefficiencies. The logic of development itself was thwarted by the new logic of self-serving regulators who formed India's vast bureaucracy. Though the policy framework did lead to some level of technological capability in IT[2], the regime was not geared to facilitate efficient, quality conscious production based on economies of scale or scope, constant technological upgrading, competition and hence returns on investments.

Prime Minister Rajiv Gandhi's vision of a rapidly modernising and technologically powerful India, led to the announcement of a new national computer policy in 1984 (GoI, 1984), which legitimised the assembly business by permitting large scale imports of computer kits from South East Asia. The policy which effectively bid farewell to indigenisation and self-reliance also initiated a gradual shift from physical to financial controls on industry. The policy resulted in a 'kit culture' promoted by a large number of small entrepreneurs who lacked design skills and the investment necessary to build economically viable hardware manufacturing units. However, the policy was successful in making personal computers (PCs) more easily available to users.

Meanwhile, on the macroeconomic front, mounting government expenditure and fiscal deficits throughout the 1980s, and an alarming depletion of foreign exchange reserves, led to a major crisis in 1991. This sorry state of affairs, coupled with the success stories of many East Asian countries, led to the realisation that the Indian economy was becoming not only increasingly inefficient but also marginalised in the world economy. The macroeconomic crisis further provided the opportunity and the necessity to liberalise and to establish a firm linkage with the global economy (Bhagwati & Srinivasan, 1993). Thus the structural reforms that were begun in 1991 sought to link India's economy with the rest of the world by aggressively inviting direct foreign investment and establishing quality consciousness in Indian industries, and by attempting to make them internationally competitive. These reforms can be seen as having initiated the process of globalising the Indian economy. As far as the IT industry is concerned, policies since 1991 have been qualitatively different from the previous decades. While the 1984 policy was aimed at giving a boost to computerisation, the liberalisation measures undertaken since 1991 have been explicitly aimed at globalising the Indian IT industry.

This implies a radically different approach to development, an approach built on a premise of 'mutual dependency' (Prahalad, 1993) rather than one built upon complete self-reliance. Policy changes since 1991 seem to endorse explicitly a position of 'mutual dependency', heralding a regime that calls for active collaboration with the global economy and its constituent units, be they states or global enterprises. This policy volte-face[3] from protection to globalisation has presented the Indian IT industry with severe transitional problems. Indeed, the industry's future hinges on the manner in which it adapts and responds to these changes in state policy. It is to these

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[1] For a brief review of industrial policies till the mid-1980s, see Ahluwalia (1988).

[2] For instance, systems design capabilities were built up by firms such as HCL (now, HCL-Hewlett Packard), DCM Data Products, ORG, and Wipro Infotech.

[3] N. Vittal, the Secretary of the Department of Electronics (DoE), the policy making and implementing body in the area of electronics and computers, has also characterised policy changes from 1991 onwards as "a 180 degree U-turn" (Vittal, 1994).

concerns that we turn now[4].

4. The death of the hardware industry?

4.1 From manufacturing to trading and systems design

India's import substituting policy regime forced firms to manufacture computers within the country. However, indigenisation proved difficult, and even impossible to achieve due to the rapidity of technological change and the non-availability of locally made components[5]. In a radical move, the 1991 industrial policy abolished the system of industrial licensing for the computer industry, and increased the foreign investment limit in Indian companies to 51 per cent, thereby signalling the entry of multinational corporations (MNCs) and a higher degree of competitiveness. The nature of computer hardware manufacturing in the country began changing around this time, from the classical sense of producing a good from the component level i.e. vertical integration, to either specialised manufacturing of some components such as printed circuit boards, integrated circuits and moulds, wherein a firm has the advantage of volumes, or the integration of bought components, testing and further value addition where possible. By 1993, severe competition from MNCs and a slackening of government buying had led to extremely thin profit margins for the industry.

More recently, the government's annual budget for 1994-95 has further accelerated the move towards globalising the IT industry through large scale reductions in customs tariffs. According to the new tariff structure, while computer systems can be imported into the country at 65 per cent customs duty, crucial inputs for the industry such as central processing units, hard disk drives and memories can be imported at 50 per cent duty. As the tariff differential between inputs and full computer systems is marginal, it has effectively rendered manufacturing for the low volume market economically unviable. The policy has thus benefited importers and traders, as well as illegal assemblers who pay no customs tariff[6], and has put manufacturers at a relative disadvantage (for details see Computers Today, 1994; Economic Times, 1994). Further, the capital intensity of the hardware industry also offsets any incentive that arises from India's low labour costs.

Firms with international linkages stand to benefit from the 1994 tariff reductions, as liberalisation makes business with foreign partners easier[7]. However, firms that have invested in setting up manufacturing facilities and in building up design capabilities are having to make difficult choices about future strategies[8]. Although idle or underutilised manufacturing capacities are causing problems, the software strengths inherent in many of these firms are enabling a remarkable transition from manufacturing to value addition through systems integration, as their core business activity.

Thus, globalisation is changing the profile of the hardware industry with a current turnover of around $470 million, from assembly and manufacturing to trading and systems integration. While the shift from manufacturing to trading is certain to emphasise issues concerning brand names at the expense of more substantive issues of

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[4] Data for this paper were collected through the analysis of 44 interviews with Indian government officials and company executives during January - May 1994.

[5] The import content of an Indian made computer is at least 64% (Verma, 1993).

[6] Nearly 18% of the total revenue from domestic microcomputer sales in 1993 went to the unorganised, illegal assembly sector, also called the 'grey market'. This share is expected to increase to 30% by 1997 (Subramanian, 1993).

[7] These include firms like Digital Equipment (India) Limited (DEIL), Tata Unisys Limited (TUL), Microland, Modi Olivetti Limited (MOL) and Tata Information Systems Limited (TISL).

[8] These include DCM Data Systems (DCM DS), Pertech Computers Limited (PCL), Electronics Corporation of India Limited (ECIL), International Computers Indian Manufacture Limited (ICIM), and Wipro Infotech Limited (WITL). Some of these firms have been assembling or manufacturing systems based on indigenous designs.

technology development, the trend towards systems integration may yet represent an immensely important niche for Indian IT firms. It may also be the only viable alternative for the very survival of the Indian hardware industry.

4.2 Implications for domestic technological capability

Although globalisation will have a positive impact on IT use in the country due to price reductions and improvements in quality as a result of competition, there is a possibility that it may have a negative impact on the technological capability of some domestic hardware manufacturing firms. Import substitution had forced these firms to painstakingly build up the capability to manufacture systems based on indigenous designs, often at great economic cost. Liberalisation and the ready availability of foreign technology may lead to a gradual waning of such skills. Further, these firms have traditionally invested some resources into in-house research and development (R&D), which has enabled faster technology absorption. However, the current policy environment has made these minuscule but locally relevant R&D investments economically unsustainable. There may be two possible ways of preventing the total loss of domestic technological capabilities. The first is to make crucial inputs available to these firms at very low customs tariffs so that they may be encouraged to continue investments in systems design and manufacture. The second alternative which will also have a direct impact on IT use and the growth of the industry is to implement a policy with a renewed focus on computerisation and IT applications for the domestic market. A large and healthy domestic market for IT applications will help build locally relevant capabilities and design skills, as well as improve the domestic IT industry's turnover. This can also serve as a platform for exports. Unfortunately, the government lacks such strategic thinking for deploying technology for local developmental applications. Liberalisation and globalisation may imply less government intervention, but by no means need it imply the total absence of any role for policy that is promotional and hence positive in character. In a globalised, market economy, strategic thinking from the government is essential to direct attention of entrepreneurs to the special needs of the domestic economy.

4.3 Policy for hardware exports

Realising that an economically sustainable computer hardware industry needs to be internationally competitive, the government has been specifically promoting hardware exports through the Electronics Hardware Technology Park (EHTP) scheme, established in 1993. Units established under the scheme are entitled to several fiscal incentives and duty free import of all their requirements. However, the scheme required the concurrence of several government departments and ministries before it could be finally approved (Vittal, 1993). Thus the necessity of inter-departmental coordination and cooperation in the implementation of such schemes and projects cannot be underestimated.

As current policies have made manufacturing for the domestic market less profitable than before, some large firms in the country are targeting contract manufacturing for foreign firms as a means to export as well as to make the latter invest in the local company's infrastructure. For instance, the contract manufacturing agreement that PCL has signed with Dell to supply $50 million worth of populated motherboards has enabled the former to set up very expensive assembly lines at Dell's expense. At the same time, PCL invests export profits into domestic market related activities. PCL's export driven strategy enables the company to manufacture and export while earning incentives from the government including the right to import systems at lower duties. Through its strategy of 'mutual dependency' with Dell, PCL has ensured a niche for itself, while both parties gain in the process.

4.4 Multiple linkages with the international IT industry

Globalisation has resulted in Indian IT firms seeking multiple linkages with foreign firms. Generally, such linkages involve local firms in a variety of technological and business alliances with foreign firms. For instance, almost every company among the top forty revenue earners in the Indian IT industry has one or more tie-ups with international IT companies, which range from joint ventures with equity participation and technology transfer arrangements, marketing and distribution, to software development and contract manufacturing of peripherals or hardware.

A tie-up with a reputed international company has several perceived advantages in the domestic market. It provides credibility to the newly established firm, helps market the firm's financial requirements better as investors usually expect good returns from a foreign alliance, and tends to attract better quality manpower (Kannan, 1993). Another possible explanation for the rapid increase in tie-ups is the lack of a brand image for Indian

products. India could profit from South Korea's successful experience at creating large *chaebols*[9] with international brand images, through government-industry cooperation. The lack of a brand image is a major constraint on export growth for software and hardware firms. Tie-ups with foreign firms are thus seen to be necessary to gain a foothold in alien markets.

Although globalisation of the economy since 1991 has brought every major international IT company into India, many prefer marketing and distribution arrangements to any long term commitment to the relatively small Indian market. Whereas such ventures do not contribute to the development capabilities of Indian firms, agreements involving some amount of value addition by the Indian partner would help to keep domestic capabilities alive, particularly when international linkages are affecting the very survival of indigenous design skills.

Along with the increase in international linkages, there is a whole new trend among Indian IT firms to link up with several small, local firms in order to create localised services and therefore closer relationships with customers. HCL-HP's setting up of a number of subsidiaries at the local levels, called Frontline Solutions Limited to service first time users is a case in point. TISL and DEIL have also taken on local business partners for marketing and distribution. PCL has a number of tie-ups with Indian software freelancers, and provides them with packaging and marketing support. Thus globalisation has resulted in Indian IT firms expanding their horizons not merely outwards in terms of linkages with the international industry, but also within, into hitherto unexplored local markets.

5. Software exports: A case of successful policy?

5.1 Policy for software exports

Software export promotion in India began as early as 1970 with the government permitting import of computers for software export purposes. Since then, such imports have been gradually liberalised, but against stringent export obligations from importers. However, at least until the mid-1980s, these measures were often preoccupied with curtailing computer imports rather than encouraging software exports.

By the mid-eighties, as foreign firms increasingly turned towards India's low cost, skilled software professionals, the government began to consider seriously the provision of infrastructure and incentives for software exports from the country. A new software policy was announced in 1986 (GoI, 1986), based on the concept of 'flood-in and flood-out', i.e. to let in the latest foreign designs and software development tools in order to enable the Indian industry to produce world class software for exports (Sampath, 1988, p.66). However, the government failed to create and sustain a large domestic market for software and IT applications, which could have provided the industry with immense opportunities for experimenting and learning. This in turn could have helped the industry in its export efforts. Another major initiative has been the Software Technology Park (STP) scheme, launched in 1990 to provide 'motherly treatment' for companies and small entrepreneurs who cannot afford expensive communications facilities. Units in an STP are eligible for liberal import of hardware and software tools, tax exemptions, and easy access to satellite links. There are nearly 225 software units operating under this scheme. Thus, the government has been actively encouraging software exports since the late 1980s.

5.2 From 'body shopping' towards offshore activities

India exported software worth Rupees (Rs.) 10 billion ($330 million) in 1993-94. The export turnover is expected to reach $450 million by the end of 1994, and $1 billion by 1997 (NASSCOM, 1993). Although almost 59 per cent of the current software exports from the country can be characterised as 'body shopping', the practice of sending programmers to work on site abroad, the criticisms[10] levelled against it by some in the industry and government are unfair. This is because body shopping is essential for building credibility and trust between the Indian firm and

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[9] Large South Korean firms are called *chaebols* (see Wade, 1990).

[10] Body shopping has often been criticised as the mere export of coding skills and that it makes no real contribution to the development of the software industry's capabilities or in the promotion of India as an international source for high quality software.

its foreign client. However, the rapidly increasing interest among even small software firms to obtain satellite links proves that there is a definite trend towards offshore activities, including export of projects and turnkey solutions.

There are tremendous opportunities for India to help foreign companies downsize. But the most important hurdle facing the numerous small software companies in the country is the lack of a record or history of projects behind them. The government, which is the single largest customer for customised software, can enable this process by entrusting the industry with challenging applications development jobs. However, most of these jobs either go to public sector companies or are executed in-house. It would be in the general interest of the industry if such projects were equally accessible to firms in the private sector. Interestingly, several public sector companies are hiving off their software divisions into separate units and some have also entered into tie-ups with foreign firms. For instance, Hindustan Aerospace Limited (HAL) has entered into an alliance with British Aerospace to develop aviation software. Steel Authority of India Limited (SAIL) is also separately marketing its process control software. This is indeed an important development, as software manufactured by such units are generally specialised and involve high value addition.

The development of packaged software is only in its initial stages in the country, with firms like Tata Consultancy Services (TCS) and Infosys Technologies Limited selling their products abroad[11]. However, it is doubtful if Indian companies are capable of frequently risking the huge investments necessary for efforts at international marketing. Globalisation has presented some Indian software firms with an innovative opportunity to serve as 'software labs' for MNCs. In order to save its in-house research capabilities from dying due to globalisation, Wipro Infotech has converted its R&D unit into offshore 'software labs' for MNCs such as Sun, Tandem and Chorus.

Although software exports are on top of the priority list for most firms, a more pragmatic opinion might suggest that the government got carried away with software exports. India's best software engineers are leaving the country for lucrative jobs abroad, and among those that remain, many are being used for mere coding, as against systems development. Further, the industry is characterised by fissiparous tendencies, as small and new companies are established and break up rather quickly when individuals leave for better jobs at home or abroad. The absence of brand image, inadequate marketing resources, and the paucity of cheap finance also constrain growth.

As the future of software exports depends largely on offshore projects, the government could set up a body to coordinate the activities of the DoE with those of the Department of Telecommunications. India's missions abroad could also help the software industry by using their trade cells to provide information on current trends and software requirements in important foreign markets. In short, there is an urgent need to sell imaginatively a vision of India as 'India Incorporated'. Further, in terms of ensuring the future of the software sector and its capabilities, the need to update continuously relevant software engineering and systems design skills cannot be overstated.

5.3 Applications development for the domestic market

A major drawback of current policy is the absence of any consistent effort at either applications development for domestic use[12] or the creation of a strong domestic market for software (See Gupta, 1994). With the value of domestic software production reaching only Rs.6.95 billion ($225 million) in 1993-94, the possibilities for applications development and further growth in the domestic market are enormous. The realisation of this potential is now slowly leading to a shift in focus from manufacturing to applications development. This could be further enabled if the government were to make a commitment to computerise at least one government department every year. This would not only improve services to the public but also help the IT industry to plan its investments in

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[11] Examples include E.X, the accounting package from TCS, and DMAP, the distribution management application package from Infosys. Firms such as OMC Computers Limited, which have inadequate marketing resources, sell their packaged software through foreign partners.

[12] There is an argument that the government should have first helped create a software industry and then backward integrated into hardware rather than vice versa. Some industry watchers hold that the lack of a sufficiently developed local software market is the result of the government's hardware oriented policies (see Hebalkar, 1988, pp.74-78).

accordance with the expected growth in IT use. However, important areas for IT use such as banking, tourism and finance have a number of inter-departmental policy linkages, and weak inter-departmental coordination within the government may prove to be a constraint.

The customs tariff reduction on software imports, announced in the 1994-95 annual budget, has the potential of boosting indigenous skills through greater exposure to international software as well as increased competition. The lowering of import tariffs will also reduce piracy and increase the availability of machine critical software. Further, the May 1994 amendment to the Indian Copyright Law empowers the government to punish those who breach the copyright or engage in piracy. The amendment has also for the first time specified what is legal and illegal copying of software, and defined who an author is and what his or her rights are. The new law may help to encourage software development for the domestic market.

6. IT diffusion in India: A lack of policy emphasis

With liberalisation and the ensuing globalisation, the use of IT to enhance competitiveness and productivity has become an imperative not merely for Indian industry, but also for the government and administration to respond rapidly to the needs of an economy in transition. Sen (1993) expresses this forcefully:

> *...there is an organic linkage between the general macroeconomic conditions of a country and the state of a critical infrastructural sector like informatics, which can be ignored only at some peril particularly when major structural changes are being contemplated.*

The fact that IT diffusion in India is still in its infancy suggests several possible explanations. On the one hand, the protectionist policy regime stressed production as against IT use, and made IT procurement an expensive[13] and procedurally difficult proposition, and on the other, the government's attitude that computers were meant for social elites limited computerisation within government and administration. It could also be argued that the use of IT in a resource poor economy plagued by unemployment presents the government with a politically and socially sensitive problem. This is often surmounted by inadequate IT awareness, and a lack of understanding of the importance of IT in improving administrative and business operations. It is here that governments can play very effective roles, and precisely where the Indian government had failed to convince the masses early enough. As a result, almost four decades after the first computer entered the country in 1955, and after more than two decades of policy for IT, there are only around 1 million PCs in use in the country. With an annual turnover of Rs.34,540 million ($1.5 billion) the entire Indian IT industry contributes less than 1 per cent of the country's GNP of $450 billion.

At a more basic level, policy has failed to convince people of the need for change, and the need for improving productivity through computerisation. This awareness is now creeping in, not because of any policy emphasis on IT use, but simply because businesses are trying to cope with India's globalising economy, and the accompanying high levels of competition from MNCs. At this juncture, it is important for India, and indeed for any industrialising economy on the path of economic restructuring and liberalisation, to strengthen the country's IT and telecommunications infrastructure. In the absence of such an infrastructure and a culture of IT use in government and business, there is a very real danger of the domestic industry succumbing to increasing international competition from MNCs as well as from other industrialising economies (See Narasimhan, 1993; Sen, 1993).

In a positive move, the gradual change in the government's 'controlling' attitude has led many regional governments in the country to establish organisations that direct or advise on computerisation within their departments. As the government and the public sector account for nearly 70 per cent of the total IT market in the country, they could provide greater consistency and a great fillip to the IT industry by progressively increasing their IT use. But the DoE recommendation that all government departments earmark at least 1-3 per cent of their annual budgets for procuring and utilising electronics and IT (Vittal, 1993), has not met with much success. However, the government's recent focus on infrastructure, progressive deregulation of public utilities, banking and financial services, and the overhaul of the telecommunications sector can be consciously used to begin a new drive for

[13] It has been estimated by economists that an increase in the price of a computer by 10% usually depresses demand by 15% (Flamm, 1988, p.69).

computerisation in the country, thereby positively impacting the growth of the IT industry[14]. Further, as liberalisation proceeds, the use of IT in government is bound to increase in order to reduce procedural and bureaucratic delays so that the 'velocity of business' in India is no lower than anywhere else in the world (Sen, 1993). In effect, any future policy will have to be oriented towards the IT user and user industries.

7. Conclusions

India's protectionist policy regime had ensured a competitive advantage for hardware manufacturers in the domestic market. But with globalisation, the advantage has shifted to software exporters and systems integrators. What differentiates one IT firm from another is no longer technology, but how each one understands the client's needs, and provides solutions that support them. Value addition through systems design and systems integration as well as custom based software applications, software exports, strategic tie-ups, focus on niche markets such as specialised board design for small batches of products, and developing brand images are issues that need consideration by the Indian IT industry.

Globalisation has succeeded in making Indian IT firms conscious of the need to think globally in order to become efficient and competitive. It has changed their perceptions about themselves and their capabilities vis-a-vis the global market, and this in turn has encouraged them to position themselves around their core competencies. Current survival strategies of most IT firms in the country have been to move towards software exports where profits are higher and tie-ups with foreign firms. EHTPs and STP's are providing new opportunities and incentives for firms willing to export software or hardware or those that are willing to do contract manufacturing for foreign firms. Most Indian IT firms are becoming increasingly outward oriented, and some are becoming resource centres for MNCs. This may have important implications for the use of existing skills for domestic purposes. The implication may be positive to the extent that skills developed through work for foreign firms may lead to better designed systems or software for the domestic market, and negative to the extent that local skills may be increasingly directed towards the more lucrative work for MNCs rather than for domestic purposes. Therefore, it becomes imperative for the government, the largest IT user in the country, to particularly encourage applications development for the domestic market. Contrary to popular perception, liberalisation has much to do with the role of government. It should imply a move away from a regulatory state to one that nurtures industry.

The Indian IT industry has thus been responding and adapting to policy changes in the 1990s. Globalisation has left IT firms with very little option but to make hard choices with regard to their core business activities and their future niches. Many firms have been severely shaken by the rapid rise in competition, shrinking profit margins, and the organisational changes necessary to cope with a drastically changed economic and policy environment. And many are imaginatively responding to the challenges, thereby helping to improve IT use in the country.

We have seen that India has not only been able to enter the technologically sophisticated realm of IT, but has also learned from policy failures and has been able to adapt and change to meet the requirements of the 1990s. The keywords to remember are adaptation and change. Less industrialised or developing economies, heterogenous as they are, need to adapt their IT policies to suit not merely their socio-economic priorities, but should also continually monitor and analyze the opportunities and constraints posed by globalisation. Policies need to aim at encouraging IT use, and then depending on the idiosyncrasies of the particular market, move up the ladder of technological capability into software services and systems integration. In a global system, more than any others, poor countries cannot afford to remain technologically isolated, as economic well being has come to depend on technology and its application for development.

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[14] The computerisation of the financial sector has served as the engine of growth for the IT industry in several countries (Flamm, 1988, p.72).

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Software development capabilities - A comparative analysis: India vs. The Philippines

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...the race is not between companies, but between countries...[1]

Abstract
This paper presents the software development capabilities of two nations in the global software market: India, its biggest emerging-economy player, and the Republic of the Philippines, one of its smallest players. Each nation will be examined with regard to its labour, tools, infrastructures, firms, and government. A wealth of conflicting information exists on India, and there is a dearth of even rudimentary information on the Philippines. It is intended that the primary contribution of this paper will be to provide a synthesis of consistent information on India and to present some much-needed facts about the Philippines. Analytically, it is hoped that this paper will supplement the material elsewhere on exporting software from emerging economies in general and will provide a basis for understanding some of the dynamics of choosing not only a software-supplier firm, but also its nation. Perhaps the current comparative analysis can aid in understanding some of the differences between these two diverse players and will provide some useful inferences as to how knowledge-based service industries can be fostered in human-rich, capital-poor nations, and whether developmental models such as Yourdon's (1994) are valid.

1. World software market, Asia, and ASEAN[2]

At present, the world computer market (hardware and software) is estimated to be on the order of $500 billion, of which software and services account for $300 billion. Approximately 62 per cent of this market is English-speaking (1990 and 1995 estimate), which indicates that English capability (present in both India and the Philippines) is an important asset for any nation wanting to serve the global software market at large. By the year 2000, the worldwide software and services market is expected to grow to almost $500 billion.

Several trends are moving the worldwide industry toward more outsourcing to emerging economies (Kim, et al., 1989):

1 Proliferation of productivity tools and management systems that make structuring tasks and communicating easier;
2 Standardization of programming languages and environments;
3 Software modularization and code reusability;
4 Easier transportability of software via improved international telecommunications;
5 Shift in the systems cost structure from 80:20 hardware: software costs in the 1960s to 20:80 in the late 1980s and 10:90 in the early 1990s; and finally
6 Shortage of qualified personnel in industrialized nations (which are also more expensive than qualified personnel in emerging economies, as described below).

The current programmer deficit (worldwide) is estimated at 1 million people, and by the year 2,000, Japan alone may need about one million more software engineers and programmers (Mijares, 1992, p.33). With regard to wages:

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[1] Mango, 1992, p.6.

[2] ASEAN - Association of South East Asian Nations - consists of the following countries: Singapore, Malaysia, Brunei, Indonesia, Thailand and the Philippines.

> *... hourly rates for offshore programming, unloaded with travel or communications costs, average about $20 an hour around the world ... for highly trained people, PhDs in many cases ... rates for contract programming in the U.S. range from $50 per hour to as high as $150 per hour for very senior people.* (Krepchin, 1993)

In the ASEAN region, Singapore has become a major software production and regional marketing base with total software and services sales (domestic and export) at over $750 million in 1992 (DBP, 1993, p.6). Malaysian sales of software and services (domestic and export) totalled over $570 million in 1991 (DBP, 1993, p.6). However, both nations are facing a shortage of IT personnel and are also looking outward for subcontractors. The software industry in Thailand is in its infancy, and Indonesia is the least developed of all, with most activity consisting of translating foreign packages into the Bhasa language. As described in more detail below, Philippines software and services sales (domestic and export) may have been in the neighbourhood of $250 million in 1992.[3] Indian software and services (domestic and export) produced in 1991 totalled $546 million (described in more detail below).

2. India

2.1 Labour

The average per capita annual wage in India is $320, and the government caps the monthly salary of Indian corporate executives at around $1,600/month ($19,200/year). Expenses provided by their companies, however, can total much more. For software producers, the figures are, of course, somewhere in-between (Stone, 1991, p.42):

> *In the US, a skilled software writer may cost a company $100,000 per year in salary, benefits, office space, insurance and equipment. Compare that with the $10,000 a year that Digital pays for an equivalent worker in Bangalore.*

Indeed, Gibbs (1994) estimated that an Indian programmer can cost (facilities included) $125/hour vs. the $925/hour required for a U.S. programmer. International salaries (facilities not included) for professionals (on average) and for programmers with 3-6 years' experience are shown in table 1 below.

Table 1: Annual salaries

Country	Avg. professional ($)	Programmer ($)
U.S.	35,000	n/a
Hong Kong	n/a	20,000
Singapore	14,000	16,000 - 17,000
India	5,500	5,000
Philippines	3,100	3,000

Source: U.S. Dept. of Labour, 1990; Bhatnagar & Jain, 1991; Apte, 1990.

Computer education facilities have been actively promoted by the government and today there are 500 computer education centres, 1,000 technical institutes and polytechnics, and 500 universities, colleges and research institutes, producing 200,000 graduates annually in various disciplines supplying an appropriate background to computer programming (Lakshminarayan, p.118, in Cyranek & Bhatnagar, 1992). In fact, India has developed the world's third largest pool of scientific manpower and,

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[3] Clear and consistent figures are not available. However, exports are presented in the Philippines section below at US$50 million (1992), and domestic software sales at US$225 million (1993). It is probable that the domestic figures for 1992 were somewhat lower, hence the total estimate of US$250 million. Unfortunately, the domestic figures may be understated because they do not include in-house software work or system software that is bundled with hardware. On the other hand, they may be overstated, because the sales figures might include imports.

> *has a growing brain bank of 2.5 million technical personnel and the second largest English speaking manpower resource in the world.... The quality of technical training is comparable to the best in the world.* (NASSCOM, 1992, p.1)

Large though it may be, however, the Indian software engineering labour force is still 20 times smaller than the U.S. (Montealegre, 1994, p.1), and although the training programs are among the best in the world improvements are needed to match skills required in the marketplace with skills provided in the training institutions. The marketplace needs programming skills in C and IBM platforms, and software engineering and project management expertise. However, most institutes train people in COBOL and in popular packages such as Lotus, DBASE III and WordStar. Although trainees generally hope for good jobs as a result of their training, most end up with computer operator jobs (Dataquest, 1994). Training (the most profitable segment of the computer industry) continues to grow (55.6 per cent in 1993-4) but the Department of Education and much of the industry is concerned about the training quality, and India may be facing a severe shortage of professors in computer-related subjects (Lakshminarayan in Cyranek & Bhatnagar, 1992).

Another problem is the 'brain drain'. Heeks (1992) estimated that about 15 per cent of Indian software developers working on exports emigrate each year, mainly to the U.S. and Australia. This figure puts an obvious drain on Indian national resources but it may also result in a worldwide network of contacts and knowledge that the nation may draw on, if it chooses to do so.

2.2 Tools and infrastructures

A wide range of platforms are available in India, from Pcs to mainframes, lower-level languages such as COBOL to C++, other 4GLs, and more (NASSCOM, 1992, p.2):

> *Indian software developers have experience on all leading computer systems like IBM, DEC, UNISYS, WANG, HP, DG, NIXDORF, GEC, DDE, Olivetti, Bull, Siemens, NEC etc. A large number of systems of these companies are liberalized for software export. A wide range of indigenous computer hardware is also used for software export projects.*

However, more of the latest productivity tools are needed (e.g. computer-aided software engineering), and the industry needs to increase availability of certain hardware platforms, for example IBM.

The government of India has designated software a priority industry for both the export and domestic markets. The Ministry of Commerce and the Ministry of Industry have been involved in establishing special export zones with state-of-the-art computing and communications facilities and establishing incentives such as duty-free equipment imports and 5-year tax exemptions. The Department of Electronics has been responsible for promoting the electronics and software industries and has taken a major role in improving electronics education. The Department of Telecommunications is modernizing the nation's telecommunications infrastructure, and liberalization efforts are underway. In fact, the government is even improving its own systems. For example, the government recently approved a joint-venture license application in four days - not months - making headlines in both the general and trade press.

India's telecommunications infrastructure, which had traditionally been state owned and operated, is undergoing some amount of deregulation and it is hoped that the private sector can play a major role in improving the infrastructure. India currently holds 8 million phones for 850 million people, with a waiting list of 2 million, but the Department of Telecommunications has planned a massive expansion to 20 million telephones by the year 2000 (just over 2 phones per 100 people), and plans also exist to provide a telephone in each village of the country by the year 2,000. Although the domestic infrastructure is fairly bleak India's ability to hook into the global marketplace is surprisingly advanced and is improving rapidly, including high-speed data networks for software export. Global connectivity is important for connecting to foreign software partners/clients, but poor domestic connectivity can hamper global connectivity and may have an impact on connecting to important business and technological resources within the country. In addition, telecommunications can provide access not only to business partners but also to hardware and software abroad that are unavailable at home, thus alleviating another constraint: availability of up-to-date technology.

Intellectual Property Right (IPR) has been a critical deterrent to firms considering either selling software to India or developing software there (Stone, 1991, p.42):

> *One of the biggest concerns that software companies have is security. Their product is notoriously easy to steal. It is estimated that as much as 90% of all software in use in India has been pirated.... "Lotus and Microsoft don't have [software development] centres like this [in India]", he says, "because they are worried about piracy.*

In other words,

> *The competition for a 5000-rupee (approximately $165) Indian spreadsheet isn't a 15,000-rupee imported copy of Lotus 1-2-3, but rather a zero-rupee pirated copy of Lotus 1-2-3* (Montealegre, 1994, p.1).

In practice, not only are zero-rupee copies of software passed between colleagues, but pirated software is also sold commercially at 1/4 the price of the original (on average). It is estimated that losses to Indian companies due to piracy have totalled $25 million per year and that the worldwide loss was $10 billion in 1992 (Sharma, 1994). Progress is being made in the IPR arena, however (Sharma, 1994):

> *India's amended copyright laws, passed by parliament this month, will boost sales of domestic software products, helping the industry to grow by 50 per cent in the 1994/95 financial year, officials said....[The new laws will] seek to imprison software pirates for up to three years and fine them between 50,000 rupees ($1,613) and 200,000 rupees ($6,451). ... Apart from punishing defaulters, the amendments have also for the first time specified what is legal and illegal copying of software, and defined who an author is and what his rights are.*
>
> It is expected that the new laws will boost the local software industry by about 50 per cent in the first year, especially package development, which has been avoided by many software firms because of the lack of protection. Without enforcement, however, the laws will have no impact. Fortunately, actions are being taken in the enforcement arena, as well (Sharma, 1994):
>
> *Two of India's main computer industry bodies - NASSCOM and the Manufacturers Association for Information Technology (MAIT), which represents the hardware makers - have jointly launched a firm called the Indian Federation Against Software Theft (InFAST) to curb software piracy and take pirates to court.*

2.3 Firms

In general, the industry consists of a few big players and many small ones as shown in table 2 below:

Table 2: Indian software firms

Type of firm	Number (1990)	Number (Est.) (1995)	Annual growth (Est. %)	Exports (%) (1990)	Exports (Est. %) (1995)
Big	2	2	0	48	36
Medium	15	30	15	30	46
Small	500	805	10	22	18
Total	517	837	-	100	100

Source: Bhatnagar & Jain, 1991, p.41.

Ninety-five percent of the firms in the Indian software industry are independent firms capitalized at an average of $40,000. As in most emerging economies, capital scarcity yields in difficulties acquiring the latest technology and information, setting up overseas offices, sustaining the business during software package development, and other problems. Although private capital is scarce, software firms have received substantial benefit from government incentives.

Unfortunately, small size (and capital scarcity) can inhibit confidence of a potential overseas partner, does not lend itself well to learning how to manage large projects, and can restrict the scale and scope of services that can be offered, as well as international marketing capability. Most programmers come out of college without enough knowledge about working in a structured environment or large systems management. Predictably, work experience

often fails to provide these skills, too (Yourdon, 1993, p.291):

> *Another aspect of Indian systems development projects is their size: most are tiny by U.S. standards. The vast majority of projects I heard about involved 2 or 3 people for 4 to 6 months; the entire DP organization often consists of only 5 to 10 people. These are legitimate projects, to be sure, and they result in useful systems, but in a typical U.S. organization, such projects would hardly merit any formal project management and would probably gravitate out of the DP organization and into the end-user organization.... these issues of size and complexity colour India's plans to build a large software industry.*

Not only may Indian firms find themselves relegated to supplying lower value-added programming services rather than project management, but such lack of skills in project management may increase the risk of a project (perhaps dangerously) if Indian firms do not properly manage their own large programming teams. This could endanger not only the projects, but their reputation and future prospects. Partnering with or subcontracting to a large partner who does know project management may provide the valuable project management skills, but only if the collaboration is managed such that skills transfer can take place. Table 3 below shows the software industry figures.[4]

Table 3: India's software industry

Year	Exports ($ml.)	Total industry revenue ($ml.)	Exports as % of total industry revenue	Domestic consumption (Rupees ml.)
1985	6	-	-	-
1986	10 - 24	57.6	34.7	700
1987	29 - 39	91.2	31.9	900
1988	41 - 52	117.6	35.0	1050
1989	54 - 67	232 - 296	26.6	1400
1990	91 - 100	467	58.4	1700
1991	128	546	n/a	2250
1992	159 - 225	-	n/a	3250 - 3380
1993	210 - 329	-	60.0	4900
1994	300 - 360	-	-	-
1995	450 - 483	-	-	-
1996	700	-	-	-
1997	1,000	-	-	-

About 2/3 of the exports to date have been to English-speaking countries, encompassing business analysis through systems implementation. In non-English-speaking countries, the projects have been mainly technical in nature, e.g. systems migration, compiler-building, programming, and code generation. Most success has been achieved as prime contractors, mainly in systems conversion and (more recently) packaged applications. Projects undertaken vary from 3-6 person-months to 150+ person-years. Industries served include banking and insurance, sports and entertainment, manufacturing and inventory, CASE, aircraft, messaging, software tools and products,

[4] A range is given where estimates vary, and fiscal years have been rounded up to calendar years (e.g. 1985-86 became 1986) in order to consolidate figures. The 1990 Domestic + Export figure does not agree with the figure for exports as a % of total revenue for the Indian software industry. Both figures are provided, however, since it cannot be determined at this time which is correct. Domestic consumption figures are given in rupees, the local currency, to provide a better representation of the local market and to avoid confounding the figures with exchange rates, which moved from Rupees 8 to a dollar in 1980 to Rupees 30 to a dollar in 1992. The 1997 figures is a World Bank estimate, providing continued liberalization, training, and telecommunications improvements. The table, like others in the paper, represents a composite from various sources cited in the references section.

pharmaceuticals, and more. As shown above, software exports from India have experienced approximately 38 per cent annual compound growth during 1989 - 1994 and in 1994 jumped to almost 60 per cent - four times the average growth rate worldwide (Gibbs, 1994).

Table 4: Software development activities ($ million)

Activity	1988-89 (%)	1989-90 (%)	1990-91 (%)
Development			
Domestic	31	21	21
Export	23	21	23
Maintenance	23	18	17
Other	23	40	39

What does all this mean for India as a software developer? One means of understanding India's software development history (and future) may be to frame the data in terms of Yourdon's 'Stages of Development'. Yourdon (1994) described four growth stages for emerging-economy information technology industries that begin with (1) low-value-added 'body shop' operations (in which programmers are transported to client sites) and proceed through (2) overseas custom software development, to (3) overseas package (or 'generic product') development and, finally, to (4) national competitive advantage - offering products that take advantage of specialized expertise.

Where is India now? Realistically, it is somewhere in the first three stages, mainly in the first. India is still a nation which primarily exports people rather than provide telecommute services. However, there appears to be a trend away from 'body shops' and toward offshore software development. In 1992, 36 per cent of software exports were offshore, up from 15-27 per cent in 1991 and 25 per cent in 1989 (Heeks, 1992; NTDB, 1993).

Regarding the third category (software packages and products) only 1-2 per cent of India's 1989 software exports consisted of packages, the rest being software services (Heeks, 1992). In 1991, however, the figure rose to 5 per cent (NASSCOM, 1992). Hence, India can hardly be placed in Yourdon's third stage of development but it may be edging in that direction.

The trend toward packages may be limited, however. Heeks (1992) predicted that entering the package market would be difficult since domestic Indian software needs and environments were so different from the global market and because marketing, support, maintenance, and upgrading would require much of the profits and also, probably, a foreign partner. In addition, only about one in twenty products succeed, thus requiring huge investments. He also cited difficulty moving from on-site to offshore because of trust and control fears of the industrialized-nation clients and partners, and difficulty moving up the skill and value-added scale.

Nonetheless, packaged software is significant not only as a lucrative export market but also because it may signal technological self-reliance and capability to innovate. Although India has not been primarily a package exporter, 1993 was the first year in which India's domestic software package needs were met primarily with domestic products rather than imports (640 million Rupees domestic packages vs. 560 million Rupees imported in 1993, a significant change from 200 million Rupees domestic and 359 million Rupees imports in 1992).

The fourth category, national competitive advantage, is more difficult to understand. As Yourdon describes it, this stage occurs when a nation has developed (and is capitalizing on) specialized expertise. Net import/export figures (i.e. the amount of money earned by a nation's software industry in terms of trade with other nations) might be a vaguely reasonable quantitative proxy, inasmuch as it measures how much a nation is capitalizing on its capabilities in the international marketplace. Heeks (1992) pointed out that this figure may be substantially lower than gross exports and may lead to the conclusion that a country is actually being harmed by its technological export activities.

2.4 Competition and differentiation via other nations

Key strengths of the Indian software industry include highly qualified, price-competitive manpower, a

telecommunications infrastructure which is undergoing substantial modernization effort, government support for export and foreign investment, lack of mainframe conceptual baggage, existing partnerships with MNCs and manufacturing presence of major firms such as IBM. Although the link between domestic and export markets is tentative at best, the presence of a huge domestic population with high purchasing power - 150 million people - larger than Great Britain and France put together - may also prove to be an asset. Marketing of the nation and its industry has also been superb. Joint ventures with western marketers, government-funded trade missions, wide publicity of successes, and industry-wide cooperation for marketing has been outstanding.

Critical weaknesses of the industry include piracy (although this may be changing quickly), shortage of international marketing capability (although it has been very successful and is currently far better off than some nations such as the Philippines), deplorable current state of telecommunications, shortage of educators, and small size of most firms, which may restrict the scale and scope of services and their placement on the value-added scale. Cross-cultural business problems may also be a weakness of firms that are just entering the international marketplace and have not yet learned to manage international business relationships. Major bottlenecks in the future may include unavailability of adequate manpower and communication links, procedural inertia that dampens entrepreneurial spirit, and shortage of training institutes that provide skills relevant for the marketplace.

Foreign MNCs are setting up offices in India, rather than merely subcontracting with Indian firms, and India is moving slowly in the direction of package production. There is a trend toward attention to quality (e.g. ISO 9000 certification). Like other emerging-economy software producers, India also faces threatening global trends towards systems development automation and 4GLs, visa problems and protectionist reactions from industrialized-nation governments, and reliance on foreign partners for marketing and/or project management, which may put these emerging-economy firms in positions of dependence and risk.

3. Republic of the Philippines

3.1 Labour

Although the Philippines is small in relation to India (60 million vs. 850 million people), there is a sizable pool of computer professionals there working in various capacities, from data entry to programming to high-level systems design and consulting (BOI, 1993, p.2):

> *There are over 20,000 Filipino Information Technology (IT) professionals working on mainframes, minicomputers, and microcomputers, but only around 3,000 of these professionals are estimated to be working on mainframes and 900 - 1,000 are working for software development and consulting firms. Ninety-nine per cent (99%) of Filipino I.T. professionals are college graduates. The Philippine Software Association (PSA), the spokesperson of the Philippine software industry, estimates that there are 7,200 programmers and systems analysts in the Philippines, of which about 5,000 are end-user firms, 400 are in software development companies and 1,800 are in academe.*

These figures are probably much too conservative, given the education figures below, and given the tendency of the BOI to have access to information from only a limited subset of firms in the industry. Nonetheless, it is worthwhile noting that most of the academe spend a good deal of time consulting, so the 1,800 represents both academic and consulting activities. In addition, it is significant that faculty availability is relatively much higher than in India.

Average 1989-90 annual professional salaries, as mentioned in the India section above, were $3,100 in the Philippines and $5,500 in India. More recent (1991-92) and detailed figures for the Philippines are shown in table 5 below. The relative positions between India and the Philippines probably have not changed in the short period between the wages cited earlier and the wages cited here (although both have probably risen somewhat).

Translated into billing rates charged to client firms, average programmer billing rates for Andersen Consulting, Manila, are $30-40, as opposed to $50-75 in the U.S. (Krepchin, 1993), and in general, U.S. rates can be two to four times as high, depending on the experience level and firm in question.

Table 5: Programmer salaries and billing rates in the Philippines

Position (Years of Experience)	Annual salary ($)	Hourly billing rate ($)
New Programmer (0)	2,300 - 3,200	10 - 12
Jr. Programmer (1 - 3)	3,200 - 4,600	13 - 15
Sr. Programmer (3)	4,600 - 5,500	16 - 19
Systems Analyst	14,600 - 5,700	20 - 24
Systems Analyst	25,700 - 6,900	25 - 30
MIS/EDP Manager or Consultant	6,900 - 11,500	50 - 100

Source: Adapted from Mijares, 1992

There are 1,800-3,000 graduates from computer science programs each year from the top four universities alone in the Philippines and 25,000-30,000 enrollees in non-degree computer courses. In fact (BOI, 1993, p.2),

> *According to the Asian Computer Directory, the Philippines is the second among Asian countries in terms of the number of training facilities for computer programming and computer-related courses. There are about 200 training centres offering short-term courses on computer programming while 30 colleges and universities offer degree programs in computer science and engineering.*

During 1989 in Metro Manila alone, there were 12,000 computer science and computer engineering students. In 1993, there were 60,000 computer training center students and 5,000 graduates per year entering the IT profession. In 1998, to meet the industry goal of $300 million in software exports, 15,000 new grads will be needed. Despite the number of training facilities, however, the quality of education has been questioned in the same way India's has (DBP, 1993, p.2):

> *Most, if not all local training schools offer "mass-production" type of courses (DBASE, WordStar, Lotus, CAD) that do not address the ever-changing needs of the corporate world. As a result, fresh graduates are unable to find employment immediately since they are not trained on the appropriate software technology needed by software firms and big multinational companies....There is a standing industry clamour for the establishment of a world-class training institute to address the human resource needs of the software industry.*

Mainframe skills, important for services export, have shown slow improvement or stasis over the past few years. In 1987, 12 per cent of the local systems workers were working with mainframes (Mijares, 1992, p.35), as opposed to 15 per cent in 1993. A wide variety of platforms and low- to high-tech skills are found in the country, like India, but of course on a much smaller scale.

The loss of educational investment in Filipino workers who have emigrated to the U.S. alone was estimated at $23 billion in 1991 and has been called "*$23 billion in foreign aid to the U.S.*" (Science and Technology Advisory Council, 1991, p.6). However, there are efforts (private and government) to use this expatriate network as a network of business contacts, information and knowledge transfer, and overseas partnership (the 'brain gain').

3.2 Tools and infrastructures

As in most emerging economies, capital is scarce in the Philippines. It consists mainly of family money, which is usually managed in a highly risk-averse manner and does not flow easily to unfamiliar, intangible 'high-tech' industries. Further, venture capital is generally not matched with market information, which is a real hindrance to start-up firms. Undercapitalization means real problems in terms of acquiring the latest technology, setting up overseas marketing or liaison offices, and being able to withstand reductions in revenues during software package development (or in general in a fairly risky industry).

Like India, a wide variety of technologies and platforms are used (see Firms section, below), but there can be difficulties in acquiring new technologies. Not only is capital scarcity a culprit, but journals and other sources of information are expensive and come late or not at all (due to a sometimes faulty mail system). Intellectual property rights (discussed below) hamper not only the flow of technology from abroad, but has even caused some locally-developed technologies to be sold outside the country without first being disseminated locally.

One of the key complaints about the government in relation to this industry is that the government repeatedly awards contracts to foreign firms without any requirement that local firms be involved and use the process as a learning ground. Kim, et al., (1989) advocated a local-foreign partnership strategy for developing nations as a means for developing expertise.

Software development has been listed as an 'export winner' in the National Export Plan for the Philippines, 1993-98. The National Information Technology Plan outlines IT initiatives to promote the industry, including telecommunications and other infrastructure improvements, such as education, etc.

DOST (Dept. of Science and Technology) provides R&D funds for companies dealing with IT. DTI (Dept. of Trade and Industry) helps look for potential markets and networks companies with potential clients and foreign partners. The BOI (Board of Investments) has been active, but not without criticism. They do award a tax holiday (during which time most start-up firms do not make money, anyway) and incentives (e.g. tax holiday on buying equipment, which is cheaper on the 'black market' anyway). However registering with BOI takes time, and the slowdown can be a real hindrance. In general, however, there is very little bureaucracy and government interference in this industry, which can be substantial aid in itself. The industry needs more help, though, financially (via low-interest loans, guarantees for private loans, and giving government software work to local firms) and with international marketing missions.

The domestic Filipino telecommunications system has been one of the worst in Asia, with an average of less than 2 telephones per 100 people. The average in the ASEAN region is over 8. There are 800,000 people waiting for a telephone line. International telecommunications, however, (crucial for overseas software development and trade) is generally good (comparable to its Asian neighbours), and many of its problems occur in 'the last three miles', i.e. the domestic infrastructure (Mijares, 1992).

The Philippines has of late been one of the most aggressive deregulators in the Asia-Pacific region, due in part to long-standing internal pressure to remove monopoly status of the long-distance carrier seen as responsible for the deplorable state of the telecommunications system (Bromby, 1994). With the deregulation moves, encouraging progress has been reported in telephone installations (172,000 in the first year after deregulation) (Tiglao, 1994) and proliferation of competition (PDCP Bank, 1993).

Telecommunications is a national priority. Almost 300,000 lines in Metro Manila and almost 150,000 in the provinces are forecast to be installed in the period 1992-96. PLDT, the national carrier, has negotiated $134 million worth of financing from the World Bank to support ten projects to establish telecommunications facilities outside Metro Manila and is working on another expansion plan which would provide an additional 1.4 million digital lines nationwide. Cellular, satellite, and enhanced network services such as paging are all planned for rapid expansion. In addition, fibre-optic and sub-marine cable systems, which have a substantial history in the Philippines, are expanding and are an important tie-in to the region and the international community.

Revenue loss due to software piracy has been estimated at $25 million. As mentioned above, software developed inside the nation has been exported without domestic dissemination and foreign firms may hesitate providing technology to the Philippines. Unfortunately, relatively little action has been taken to improve IPR in comparison with the flurry of activity in India.

Major power shortages occur several hours a day in Manila, although this is not a problem in other growing regions such as Davao or Cebu. There are substantial efforts underway to build new power plants and refurbish old ones, and rapid development of the energy sector is one of the five priority programs on the President's national policy agenda (Office of the Press Secretary, 1993).

Another of the five priority programs in the President's policy agenda is attainment of national stability and unity. Due to its relatively recent and internationally publicized history of political uprising, the Philippines has a national image problem to overcome when trying to attract foreign investment or clients.

The Filipino transportation system, although clogged with traffic in urban areas and plagued by need for repairs, is comparable to India and should not pose a substantial problem for the software industry. However, as commuting times are high, substantial manpower is lost during the time between home and office.

3.3 Firms

There are over 150 software and consultancy houses serving the domestic and export markets, and the number of these has steadily increased, as can be seen table 6 below. At least 80 of them are software houses and consulting

firms, about 40 offer bureau-type services (e.g. programming and data processing), and about 35 offer data preparation and encoding services. They include large affiliates of domestic companies, joint ventures with foreign firms, affiliates or subsidiaries of foreign firms, and independents (95 per cent of the total, capitalized at $40,000 or less).

Table 6: Filipino software firms

Year	Number of firms
1981	23
1982	31
1983	44
1984	47
1985	51
1986	60
-	-
1990	75
1991	83
1992	n/a
1993	100+
1994	150+

These independent firms are generally very small and were started by technologists-cum-entrepreneurs or were 'spun off' from large corporations. The firms generally face capital scarcity in a country with high interest rates and in which most banks require tangible collateral for loans, not professional skills and intangibles. In terms of revenue, it is estimated that only 5 per cent of them are 'big' players with revenues of $40,000 a year or more. Unfortunately, their small size is a great handicap. In the words of one manager,

> *Tata Consultancy in India has over 10,000 employees worldwide. If you have less than 200 men, you might be called a fly-by-night operation.* (Magno, 1992, p.6)

In general, managers are very well educated, but different styles and practices in the local environment can be a problem when dealing with foreign firms. Qualitative evidence found in the exploratory study for this research showed a wealth of entrepreneurship at the small-business level but not necessarily at the high-capital professional-management level. This shortage of large-scale effort may be attributed to lack of venture capital for high-technology enterprises and risk aversion by professional managers who face poor employment prospects in case of project failure (a legitimate fear in the high-risk business of software development). Firms are very competitive within the industry, and passing referrals for work between firms with different capabilities is not a strong social norm.

These small businesses have managed to collect together, to some degree, into several associations (e.g. the Philippine Software Association, Philippine Computer Society, and others), and there is a recent attempt in the industry to form an alliance for the sharing of information, technological resources, and engage in joint overseas marketing missions. Alliances have been unsteady in the past, however, and it remains to be seen whether this one will stand the test of time.

The export revenue of BOI (Board of Investment) registered firms grew an average of 16.8 per cent per year in the period 1988 - 1993. In comparison, domestic software sales increased from $480,000 (1988) to $770,000 (1991), a 12.5 per cent increase per year. Comprehensive export figures (including both BOI-registered firms and non-BOI-registered firms) show that Philippines exports have steadily grown - from $12 million worth of software in 1989, to $30 million in 1990, $36 million in 1991, $50 million in 1992, and an estimated (perhaps hopeful) $300 million in 1998.

The activities of the Philippines firms include subcontracting (domestic and export), software package development for foreign hardware producers, product development, systems conversion, and custom programming. Capabilities include project management, software conversion (from one environment to another), turnkey systems

development, programming and maintenance, and analysis and design of operating systems and applications software.

Mainframe software accounts for more than half of software exports (and is generated by the few large firms that exist in the country - hence the alliance attempt), and packaged systems account for two-thirds of the business. The software development sector of the computer industry is by far the fastest-growing sector. Systems environments range from MS-DOS to OS/400 to CICS, MVS, UNIX, and VMS, but the independent software houses (95 per cent of the total number of businesses) are primarily microcomputer-based, and as mentioned above, only 15 per cent of the software workforce works on mainframe computers.

The fact that the independent software houses are mainly microcomputer based is not necessarily a handicap, however. Personal computers account for 80 per cent of the world's computing power, and packaged software is the fastest growing segment of the global software market (20 per cent, as opposed to 15 per cent for custom software) (Bhatnagar & Jain, 1991).

In terms of Yourdon's (1994) stages of software development capabilities, the Philippines would appear to be highly advanced. On the first two stages (bodyshop and offshore development), only 14 per cent of the total number of software professionals were working overseas in 1987 (Mijares, 1992). The industry exports principally by producing software locally on an export-platform basis (BOI, 1993).

On the third category, it would seem that since, as above, packaged systems account for the majority of exports, the Philippines should be considered 'advanced' relative to India, even though the size of Philippines exports is dwarfed by India's.

Is the Philippines 'leapfrogging' over the Indian model? Perhaps not. In reality, the package export figures represent not stand-alone packages as much as they are software to be incorporated with hardware or portions of packages to be sold internationally. This is not what Yourdon was attempting to describe, and it does not demonstrate technological self-reliance or the presence of skills at each stage in the life cycle development process. Further, the total export figures are so small relative to typical international project sizes that the figures can be dominated by a few large projects and, thus, should not be fully relied upon for an understanding of the nation's advancement and capability.

3.4 Competition and differentiation via other nations

Principal strengths of the Philippines include a well-educated, price-competitive labour force, English proficiency, reasonable international telecommunications, some level of government support, less regulation than some neighbours, multicultural paradigms (from its multi-colonial history), and strong entrepreneurship.

Weaknesses include capital scarcity, small-scale nature of its entrepreneurship, bad international image of the nation, small domestic market, weak IPR and other infrastructures, scarcity of track record, need to upgrade education and technology, lack of cooperation between business and government (which may be changing), and fragmented industry (which may also be changing).

Marketing is a major problem because the Philippines has no international reputation yet for its technology industries, unlike its main competitors, India and Singapore. In addition, it seems to be facing even more difficulties than India and Singapore in finding enough capital to set up overseas marketing offices. Fragmentation in the industry has not helped matters, either.

The nation unfortunately has a poor 'brand name' (Magno, 1992, p.6):

> *... you have to downplay the origin of your company .... When we do a project abroad, we don't say that we are a Filipino company. We say that we are a south east Asian company. It doesn't sound nice but sometimes you have to do it.*

For some successful companies, there is a hard choice to make between putting another nation on the software label (thus making the firm's job easier and earning more money in the short-term for the Philippines) vs. developing the nation as a 'brand name' with each overseas project (harder to generate because of the lack of national 'brand name').

4. Summary and conclusions

First, a word of caution is in order about the 'hard' figures used in this (and all) emerging economy studies. Care must be taken to avoid using them beyond their limited reliability. Nonetheless, some general conclusions and

questions may still be drawn. First, both India and the Philippines have clearly shown that emerging economies do have some software development capabilities and that the resulting technology can be exported successfully to industrialized nations. The direction of export (emerging economy to industrialized nation) is significant in that it may be an example of 'backward' technology transfer, especially as the nations begin to export higher value-added products and services and to export indigenously generated technological innovations.

India and the Philippines are similar on several dimensions - language, technological, and managerial capability; firm size (both small); infrastructures (India has established world-class infrastructures in its export processing zones, but the Philippines has deregulated more aggressively and may improve telecommunications in general more swiftly); and problems such as the 'brain drain' and capital scarcity (somewhat worse in the Philippines, though, because of its smaller size and lack of cohesion in the industry).

In terms of differences, the Philippines has poorer marketing capability (caused by lack of cohesion, lack of capital, latecomer status, poor national image abroad, and position low on the international-marketing learning curve), a poorer electricity infrastructure (at least in Manila, one of its most important business centres), less cohesion in the industry, a less active government (which seems to be taking an informational role, rather than active marketing, aid, and incentives, like India), and much smaller domestic market to draw on (of dubious value). On the up side, however, the Philippines also has lower programming wages (with similar capabilities) and a greater proportion of faculty (possibly indicating greater capability to sustain future growth, at least in terms of labour supply). India, on the other hand, has taken much more action in IPR and international quality certification (e.g. ISO 9000) and has publicized this activity well. It has a better national image resulting from its 'First-Mover Advantage' (although it still must contend with its 'developing-nation' image). However, as mentioned above, most of the Indian exports consist of 'body shop' services, whereas most of the Filipino exports have been telecommuted software and packages (although the package figure may really represent subcontracting on packages developed by others).

This could have sizable implications for Yourdon's 'development model' as we ask (1) whether it is valid, and (2) if so, whether it is possible to skip 'stages'. Yourdon's model was based on the Indian experience. Applying the model to the Philippines has either shown that (1) the model is not generalizable to other nations, or (2) it is possible to skip stages (at least the first one, perhaps because the 'First Mover' has shown the industry that bodyshopping is sometimes unnecessary). On the other hand, the model may hold with nations over a longer period of development (the Philippines is a newcomer) as they, too, bodyshop in order to build trust and confidence with unfamiliar clients. Indeed, the history of both nations may yield implications for overall economic development stage-models and the possibility of 'leapfrogging' over industrial development on the way from agriculture to services.

A more useful topic, though, for emerging-economy businesses may be, 'Where is the learning ground for entering this market, and how must business strategy change over time?' Both the Indian and Philippines cases bring into question the necessity of a developed domestic computer industry as a base for exports (perhaps a 'stage' model, itself). Simple packages in a number of industries and business functions have been exported from both nations, but it has been asserted that the domestic market is necessary as the developing ground for more complex packages, even though the domestic and export markets are vastly different in terms of price sensitivity, quality sensitivity, and critical business needs of clients. Can packages (and exports in general) be developed based on the learning that occurs in custom export engagements rather than via generalized domestic expertise? In doing so, does the firm (and nation) damage its reputation when it fails (as sometimes it inevitably will)? Is the government an effective alternate learning ground for the industry to move into exports? The differences in the government, domestic, and export markets would suggest, 'No' but more data and analysis are needed to answer these questions. Nonetheless, the domestic market, even if not a learning ground, can provide a buffer from the violent fluctuations of the export market.

Perhaps all that can be said at this point is that India and the Philippines are facing different challenges, based not only on their different domestic environments, but also on the different international situations they face as the international market changes. India paved the way by showing that this type of work is possible. But the problem, now, for firms in other nations is to convince industrialized-nation firms to, 'Use us rather than them.' Thus, research needs to move from description of what is currently possible to prescription of how to build international business relationships and generate the trust that is so essential to beginning this type of work.

The strategy apparently used in the Philippines is one in which individual projects have a higher payoff (because the work is telecommuted rather than bodyshopped, resulting in a decrease in expenses), however, the higher profits per project may be more than offset by the difficulties in forming trust with a new partner and, thus, selling the work in the first place. In other words, they are playing a game with higher payoff and lower chance of success. Rather than being a conscious strategy choice, though, the different pattern in Philippines software exports may be a result of their peculiar history in the start-up stages of software industry development. Many (most?) of the big Philippines offshore development contracts have been formed via established relationships. Thus, their offshore programming activity may be a result of pre-established trust which cannot be assumed in the future. Indeed, failure to switch to a trust-building strategy with new, unfamiliar clients could be the core problem firms are facing when trying to sell work in the global marketplace and may prevent the industry from developing further.

The Philippines and its software industry are much smaller than India, so it will probably have to find a niche market to develop and defend. It will have to improve its marketing capability and industry cohesion, continue to work on its infrastructures, and enlist active government sponsorship for promoting the industry via government projects awarded jointly to foreign and domestic firms, promoting the 'trickle down' from export to domestic market, and providing assistance with capital (e.g. guarantees and coupling market information with venture capital), marketing (e.g. international trade missions), and technology (e.g. via improved IPR).

India must realize that it may have to change to a different management strategy for higher-value added work and different growth strategy for defending its market position and growing in different markets with new clients. It has made some impressive moves and must continue improvements in infrastructures and other areas mentioned above.

Comparing these two nations has resulted in a rich and intriguing picture of business strategy and industrial/national development. In the future, more work is needed to understand how they develop, how to maximize the benefits to all parties involved, and how to build trust and manage relationships, along with other management issues that can be applied to a wider array of global business and inter-firm activities.

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A bill of rights for the information age which recognizes the Third World

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Abstract
In a previous paper, presented by du Plooy and Roode at the Second International Conference on Development and Future Studies in Perth, Western Australia, in December, 1993, the Bill of Rights for the Information Age proposed by Glastonbury and LaMendola was analyzed and certain ethical issues which were lacking in the Bill were pointed out. In this paper the Bill is analyzed from a perspective of the so-called Third World. A number of additional clauses is added to the Bill to make it more useful and appropriate to developing countries.

1. Introduction

Bessant (1987) has pointed out that, as far as information technology is concerned, there exists a mainly one-way traffic from North to South, that is, from developed to developing nations. In an earlier paper Du Plooy and Roode (1993) analyzed the proposed *Bill of Rights for the Information Age* proposed by Glastonbury and LaMendola (1992) and pointed out that this Bill does not take the particular situation of developing countries into account.
The often naive and exaggerated expectations surrounding the introduction of information technology in developing countries have been, in part at least, the result of the strong promotion of computers and information technology as an essential component of development by international development agencies which:

> *have accepted whole-heartedly the premise that information technology must be applied and developed in Third World countries if they are not to be left behind. ... Such enthusiasm reflects the degree to which these agencies identify the major constraint on development as 'poor management skills' and see computers as 'tools for developing analytical skills among Third World managers and therefore improving decision making' by making it 'a more rational process'. Whether driven by fear or hope, these visions of computers and development show the effects of the uncritical technoidolatry that has surrounded this technology from the start. The repeated proclamations of the 'computer revolution' share a consistently ahistorical viewpoint which decontextualizes the artifact and the knowledge it represents and focuses narrowly on the technical capabilities of hardware and software. From these proclamations are derived optimistic predictions of the richer and more egalitarian 'global village' that is supposed to be the automatic and beneficial outcome of the proliferation of computer technology ..... what is clearly implied ..... is that those who do not computerize will be left out of the glorious future.* (Berman, 1992)

However, Cotterman and Malik (1993) have pointed out that these ideas create a conceptual trap since achieving the benefits of information technology and accelerating the development process are two very different objectives. The former, they correctly indicate, is achieved on a much smaller scale or basis than the latter. For instance, the former does not necessarily involve national strategies (although it may benefit from such initiatives), whereas the latter is absolutely dependent thereupon. A typical example of confusing the two issues occurs when policy makers are trapped into thinking that acquiring state-of-the-art technology is an essential condition for accelerated economic development. In this way, billions have been spent in generally unsuccessful introduction of information technology into developing countries.

2. Beyond technology

When a powerful technology is introduced into an organization or a society, it does not leave that organization or society unaffected. Information technology, like other technologies, is not neutral and can indeed be described as offering intelligence without integrity (Glastonbury & LaMendola, 1992). As such it can take on whatever rules or moral standards its designers and controllers choose. Some standards seem intuitive but are in actual fact part and

parcel of the designer's world view. This is not a shortcoming or a mistake that can be avoided but an essential condition for knowledge of any kind (Winograd & Flores, 1986).

Postman (1992, p.18) concurred when he wrote that technology is neither additive nor subtractive. It is ecological in the sense that any significant technological change to an organization or a society generates a total change. This is certainly also true of information technology. Postman further argued that the introduction of technology in most societies eventually gives rise to technocracy which inevitably further evolves into what he terms "technopoly". Technopoly, he states, is a state of affairs where technology "rules". It is based on the belief that the primary, if not the only goal of human labour and thought, is efficiency; that technical calculation is in all respects superior to human judgment; that the affairs of citizens are best guided by "experts"; that that which cannot be measured either is of no value or does not exist. Technopoly is therefore the total submission of all forms of culture, also economic development, to the sovereignty of technique and technology. Witness, for instance, the traditional view of economic development which focuses on quantifiable growth factors such as GNP, productivity, per capita income, etc. Postman warns, furthermore, that technological advances should never be superficially equated to progress.

Lyytinen and Ngwenyama (1992) stated that many IT applications are conceived from the perspective of rationalistic explanation of how information systems are used in organizations and exhibit Tayloristic work designs, focusing on the individual's task productivity. (Note the technopolist approach.) This often leads to inappropriate application designs, difficulty of use, and outright failure of many systems. If this is the sad case of affairs in developed countries, what can developing countries do to avoid it?

Bolter (1989) explained that IT is a *defining technology* in the sense that, though we can live without computers, we will be different people because we live with them. Computers are constantly serving as a metaphor for the human mind or brain, creating what Bolter termed "Turing's men", who perceive humans as information processors and nature itself as information to be processed. Bolter feared that man is changing (remaking) himself in the image of his own technology, in this case computer technology. Simply put, man is seen as computer, and vice versa. This is an important perspective which must be considered carefully in the context of developing countries.

What seems to be missing from the technopolist view of information technology is the realisation that the implementation problems and issues of information technology and information systems are often not technical but social in nature. Thus, Boland argues: "*Designing an information system is a moral problem because it puts one party, the designer, in the position of imposing an order on the world of another*" (1987, p.376). Angell and Straub (1993, p.168) remarked that "*..information systems, and the organizations they serve, are social systems, and certain systems principles, suitably interpreted, can provide a limited understanding of their behaviour*". From the real world of pragmatics, De Marco and Lister (1987) concluded: "*The major problems of our work are not so much technological as sociological in nature*".

We are still caught in a particular way of thinking that was inspired by the spectacular advances of technology in this century. Such thinking resulted in a particular form of technological Utopianism which holds that the best way to attack and solve problems, regardless of the 'state of development' of the organisation or society, is by applying yet more (and ever more complex) technology. In its most extreme form, technology becomes the end, not the means - in other words, Postman's "technopoly" reigns supreme. This is the reason why the solutions sought, and offered to society by the computer community, are mainly technological in nature. This is also why conventional systems development approaches and implementation strategies do not equip the developer with tools or knowledge for dealing with the social processes intrinsic to information systems development (Hirschheim & Newman, 1991, p.30).

In the meantime, however, society (in the First World) has changed and is still changing in many respects. Social writers are questioning the old paradigms of authority, work, family life, democracy, the nature of organizations, planning, learning, information, the role of technology, the goals of economic development, etc. According to Klein & Hirschheim (1987) such new attitudes of society had resulted in a shift from efficiency and effectiveness towards social acceptability and appropriateness, as the new objectives of information systems and information technology.

One of the values of this neohumanism (Hirschheim & Klein, 1994) is emancipation. People are demanding the right to participate in anything which is likely to affect their jobs, and expect work arrangements in a democratic

society to be driven by ethical imperatives and shared understanding. Furthermore, as information technology filters through from North to South, it encounters new cultures, differing vastly from the culture within which it originated. Within these cultures society views automation and computerization differently, often with apprehension, since it may affect their lives in ways they do not understand and care for.

How does the impact of information technology manifest in organizations and society? In what follows we briefly mention and discuss some impacts and consequences.

3. The impact of information technology on organisations and society

During the first few decades after the introduction of computers in organizations, computer systems seemed simple to implement, did away with large numbers of clerks and resulted in real financial savings. These facts tended to sweep away possible objections to the adverse affects of automation. In the nineties conditions are much different. All the 'easy' applications that were relatively isolated from the rest of the organization, are up and running well, for instance typical transaction processing systems. Other systems, such as office information systems or management information systems that are currently being attempted are quite difficult. These systems have a far greater impact on the work life of an individual, and that is why Boland (loc. cit.) observed that "*...designing an information system is a moral problem...*" The very job of a so-called systems designer is to engineer or re-engineer the job or jobs of other workers in the organization. If this is not done with a social responsibility, the final result is de-skilling, a resurrection of Taylorism and mindless monitoring of video screens (Willcocks & Mason, 1987). The technopolist's view of software development and information systems design is one of imposing the order dictated by technology, not by a sense of social responsibility - remaking the worker's world in the image of the machine.

The technopolist's view of the world disregards one crucial aspect, which also concerns us here. Society and organizations are, in terms of the general theory of systems, so-called open systems. This fact has a number of consequences, one being that the behaviour of societies and organizations are, to a certain extent, unpredictable, or, in systems terms, non-deterministic. It is therefore not surprising that purely rationalistic and positivist approaches to solving societies' and organizations' problems have met with relatively little success. As Angell and Straub (1993) have put it in a slightly different context, the problems of society and organizations are too "messy" to be solved by deterministic methodologies. Also, one cannot expect to be able to accurately predict or anticipate the consequences of the introduction of information technology into organizations and society.

It is indeed true and accepted that the impact of information technology on organizations and society is a major, and inevitable one. The organization with information technology is ecologically different from what it was before the introduction of the technology. In this sense, information technology is a determining technology - it determines to a large extent what the organization is about to become.

When discussing computer-supported cooperative work Lyytinen and Ngwenyama (1992), note that "*... many information technology applications in organizations focus on the individual's task productivity while underestimating the importance of the social content...*". It does not make much sense to propose the use of information technology in a cooperative working environment if the nature of cooperative work, especially the social content of cooperative work, is not understood. Again, the technopolist's view reigns supreme: Technology is good for you and enables you to work together, therefore it is imperative that you do so in order to increase the productivity of the group.

Bouldin (1989) and McPartlin (1990) described the "terrors of *technostress*" caused by computers. This is manifested not only by a fear of computers, a kind of cyberphobia, but also by a lack of being able to cope socially and psychologically with two widely diverging worlds, namely the clinical, accurate world of computers and the messy, inaccurate social world. Cyberphobia could be a real problem in an underdeveloped society. In a society with major unemployment, such as South Africa, computer illiterate people would often not make this fact known to their employers for fear of losing their job. Rather than admit to the fact, it has been reported that such workers often learn to use computer systems by rote rather than by understanding. Of course, the mere fact that such unskilled workers are required to use computer systems is evidence of a technopolist approach.

It is only in recent years that the work of Enid Mumford and others on a socio-technical approach to information systems development has been taken cognisance of. Similarly, the current interest in soft systems design (Patching, 1990), a methodology that has a lot to give to the discipline of information systems (Checkland &

Scholes, 1990, p.303), is mainly being expressed in first-world countries. These approaches have in them the ability to enable developing countries to avoid the errors of more developed countries as far as the introduction of information technology is concerned.

Recent cases of fraud in the lesser developed parts of South Africa have again focused the attention on the ease with which a single knowledgeable person in an organization (or a country) of computer illiterates can misuse computer systems to personal advantage.

These quotations and examples show that the impact of information systems and information technology on individuals, organizations and society at large is far-reaching, and, as far as related subject areas are concerned, wide-ranging. In order to discover whether the issues addressed here are perceived to be of real importance to a democratic South Africa, we will consider some current viewpoints on IT and IT policy.

4. The ethical use of information technology in economic development

According to Boland (1987, p.377), "*....each information system design must have the quality of organizational dialogue and the quality of each individual's hermeneutic search for meaning as its ethical standard of success*". Therefore, the information system should facilitate the organizational communication and should contribute towards a meaningful work life for the employees of the organization. Furthermore, the possible detrimental consequences of introductions of information technology, which go little beyond mere automation exercises for 'increased productivity', should be understood in order to prevent further dehumanization of our society. In a broader context, not all societies can absorb information technology without harmful side-effects such as loss of privacy, unemployment, computer crimes, technostress and similar woes.

From current literature, we now extract and briefly discuss five viewpoints which we found contributed a lot to shaping our own views on the ethics of information technology and development. In the first instance, we refer to the so-called 'core values' of economic development according to Todaro (1989). In the context of information technology, these have the following meaning:

1 Life-sustenance refers to the ability to provide for the basic needs of the individual, and the contribution which information technology can make to rising per capita incomes and greater employment opportunities (job creation as opposed to continued automation). One obvious way in which to achieve this is to promote an information technology industry. However, in view of the overwhelming competition from the First World, and the NICs, this would seem to be an impossible task. On the other hand, South Africa has had certain successes in other industries, albeit in the very artificial circumstances of sanctions and boycotting. A more useful approach would probably be to introduce or further promote information technology into various other economic sectors. It is well-known that information technology " .. *is the driving force for a new techno-economic paradigm with far-reaching effects for all types of industries and services and for the competitive position of developing countries*" (Hanna, 1991). Over the short term, however, care must be taken not to blindly replace workers by computers in the false belief that the increase in GNP would take care of sufficient new job opportunities.

2 Self-esteem can be supported by using information technology to enhance rather than de-skill a particular job, enabling a worker to work at a higher level and thereby enjoying a particular sense of fulfilment. This could be achieved in various ways. One approach would be to train workers in information technology, thereby enabling them to use the technology in their particular environment. Without a doubt the acquiring of a modern skill such as computer literacy is in itself rewarding and fulfilling. However, even more rewarding and socially responsible would be to adapt information systems and information technology to the skills level of unskilled workers, thereby pulling rather than pushing them into the information age. There is no imperative that humans should always adapt to technology - the other way round is also possible and usually more meaningful. The socio-technical development methodologies referred to earlier, such as soft systems methodology come closest to what Fromm (1968) calls a "humanistic" approach to technology. A humanistic technology is one that meets human needs because action is taken in technology development and applications to evaluate, alter and monitor its impact.

3 Freedom from servitude refers here to the ability to choose from an expanded range of choices on how to lead one's life. Information technology can enable an individual to take full part in an 'information society', rather than being increasingly estranged from modern society due to a lack of information literacy. This

is a serious problem in developing countries, especially in South Africa where the struggle is to provide houses and electricity rather than enlarging information networks. However, in this regard one could look towards experiments being done in other parts of the world where information centres have been set up in small rural towns, enabling the local population to share an infrastructure (Qvortrup, et al., 1987). The contribution of information technology therefore is that it can enable the individual to partake fully in modern and international society. Without information literacy, an individual becomes more and more marginalised in the information age. Empowered by information technology, however, even individuals living in an "information poor" society, can reach beyond that society to achieve a better quality of social and work life.

Secondly, all this may have a detrimental effect on the societies of underdeveloped nations if the introduction of information technology is not handled with care. Bankes & Builder (1992) pointed out that many underdeveloped nations have relatively closed societies, and information technology introduced to improve economic performance will end up being used for other purposes. Some of these purposes may be to increase the control over the population, rather than allowing the society to become more open. Postman (1992) in his discussion of technopoly, warned of this and suggested that one should become a "loving resistance fighter" (op cit, p.181). Loving resistance fighters are individuals who understand that, although technology has many benefits to a society, "*.... it is not the natural order of things, and is a product of a particular economic and political context. As such it carries with it a program, an agenda, and a philosophy that may or may not be life-enhancing and that therefore requires scrutiny, criticism and control*".

A non-technopolist approach to developing information systems and introducing information technology into society is therefore expressed by what we like to call the fundamental question underlying all of this discipline, namely: how to balance the contribution of information systems towards the mission of the organization with the ethical responsibility to ensure their social acceptability.

Achieving this balance is always a matter of complex, unquantifiable trade-offs between the needs of technologists, individuals, organizations and society. Note also that this second viewpoint is not limited to underdeveloped societies but is a basic requirement in all societies, be it information rich or poor. The dilemma is that underdeveloped societies see information technology as a means to leapfrog into the information age, but without the so-called ethics industries already in place technopoly could be that much more devastating.

Thirdly, Glastonbury and LaMendola (1993) proposed a Bill of Rights for the information age which, they remarked, "*should be the entitlement of all people of whatever country*". While it certainly makes sense to have a universal Bill of Rights for the information age, it should be clear from the arguments put forward in this paper that we must examine the Bill from the point of view of the developing country to ascertain whether there could be any issues specific to a developing country which are not addressed.

Even though we regard this Bill as a major step forward, we do not see adequate warning against technopoly in this Bill, since it is written from the viewpoint of a developed society in which it is possible to legislate against misuse of private data, unauthorised access to computer systems, etc. Nor does the Bill address the empowering capabilities of information technology, in the sense of Todaro's arguments. Furthermore, we have mentioned that societies and organizations are open systems that have humans as their major component and thus are non-deterministic. This means that the impacts and consequences of information technology infusion is largely unpredictable, irrespective of whether it is a developed or underdeveloped country. This basic tenet of guiding information technology infusion should be reflected more explicitly in a Bill of Rights for the information age.

Fourthly, we referred earlier to Porter's well-known exposition of competitive advantage of organizations and nations. The consequence of Porter's (1985) argument is that if some nations win, others must lose. For the world of information this creates a particular ethical dilemma. If information is something to be shared amongst all peoples, and if information technology is to be freely transferable between nations as proposed in the Bill, it means that information should be excluded from this competitive 'war' amongst nations. We know this is not so but should it simply be left at that?

Finally, Max-Neef, et al., (1989) proposed an approach to development where "*development and human needs are irreducible components of a single equation*". In particular, they state the following postulates:

1 *Development is about people and not about objects;*

2 *Fundamental human needs are finite, few and classifiable; and*

3 *Fundamental human needs are the same in all cultures and in all historical periods. What changes both over time and through cultures is the way or means by which the needs are satisfied.*

This provides a framework against which the introduction of information technology could be managed, and a national information policy be devised. As pointed out by Joubert (1994), information can be considered a satisfier of various needs while information technology can be considered an enabler not only of the satisfier Information, but of many other satisfiers in the human scale development model of Max-Neef, et al., The Bill does not touch on this very basic argument.

The above viewpoints form the basis for our critique of Glastonbury and LaMendola's Bill of Rights. To develop an augmented Bill of Rights for developing countries, the following aspects must be kept in mind:

1 The typical worker in a developing country is unsophisticated, computer-illiterate and even gullible and usually afraid to loose his or her job in an oversupplied job market.

2 Many a worker (especially office workers) in a developing country do not have access to, nor is a member of, powerful trade unions such as those which have evolved in developed countries.

3 There is an urgent need in developing countries for technology transfer from the developed countries, but without maintaining the current dependence on the information technology supplier.

4 Developing countries must secure access to various sources of information technology.

5 Developing countries must ensure that they do not become isolated from mainstream technological developments in the information technology field, with their only access to the technology being through the acquisition of packaged products, embodying the relevant skills, knowledge, components and so on in a "black box".

6 Developing countries must ensure that they gain and retain access to sources of training and experience opportunities for their workers.

7 In developing countries computers often substitute for semi-skilled and middle managers who simply are not available (Bennett, 1993), thus introducing reliable systems which have no clerical counterpart.

8 In some organizations computers are still often acquired for their usefulness as a status symbol and conversation piece rather than a productivity tool (Collier, 1993).

9 Developing countries must rid them of their enslavement to the developed world, who still favours the introduction of computer technology into the developing world by either exporting complete systems or, at most, allowing the recipient to assemble from imported sub-systems (Collier, 1993).

In the next section the Bill of Rights is expanded and augmented to address, specifically, the Third World.

5. A bill of rights for the information age in the third world

We have examined the socio-economic consequences of accelerated economic growth through the infusion of information technology. Our viewpoint has been from the perspective of a developing country, and we have deliberately assumed that the infusion of information technology is often undertaken 'carelessly' in an ethical sense. From this a number of shortcomings of Glastonbury and LaMendola's proposed Bill of Rights become evident. If this Bill is indeed to be "... *the entitlement of all people of whatever country*", then the following additional clauses are necessary. Without them, the Bill remains mainly a first-world document of questionable value to the developing countries of the third world.

Taking Glastonbury and LaMendola's Bill of Rights for the information age as a point of departure, we propose the addition of the following clauses:

1 *Developed countries shall assist the underdeveloped countries in establishing ethical checks and balances on their information technology industries.*

This is of such importance that considerations of personal data privacy, protection of copyright, knowledge sharing, etc. should be part of an underdeveloped nation's basic Bill of Human Rights rather than being addressed in separate information processing legislation.

2 *Information sharing shall be made possible amongst all nations, and, while proprietary information shall always be recognized as such, the nations of the world shall strive towards ensuring equitable access to information.*

The mere fact that the nations of the world can be and to a certain extent are already connected electronically, does not imply that the information which is being transported along these communication

channels flows freely and is shared by all. The situation is much more one of an increasing imbalance with the information-rich countries accumulating and possessing more information while the information-poor countries become progressively poorer. The situation will not rectify itself and deliberate actions are necessary to redress the situation. We do not have a 'forced sharing of information' in mind but unless there is a deliberate intention and agreement to share information, based upon the conviction that such sharing ultimately will be for the benefit of all concerned, the imbalance will simply continue to grow.

3 *Information technology from developed nations shall be transferred in appropriate form, taking cognisance of the skills level of the recipient.*

"Information technology clearly illustrates a change that has been going for some time amongst developed countries which might be defined as a shift towards 'knowledge-intensity'" (Bessant, 1987). One of the implications of this shift is the convergence and concentration of both products and processes leading to the packaging of *"all relevant skills, knowledge, components and so on into a black box"* (op. cit.). While this seems on the surface to ideally suit the requirements of developing countries, the implicit problem of technological dependence is very real: the requisite knowledge rests with the supplier and little technology transfer takes place.

4 *Information technology in developing countries should be designed in such a way that a 'good fit' between the technology and the culture of that nation is achieved.*

It is indefensible to transfer information technology unchanged and unthinkingly from a developed to a developing nation. As is the case with all technology information technology is also culturally based or has a cultural agenda and social context (Postman, 1992; Knight, 1993). Therefore, all infusions of information technology should be scrutinized as to their cultural applicability, over and beyond their cost efficiency to the organization or suggested benefit to the economy. Too often in the past, so-called first-world technology has failed because it was not culturally accepted. In other cases, such technology has changed the developing nation's society in ways that did not further the social ideals or values of that nation. Bennett (1993), for example, points out that, in Zambia, asking questions of senior staff within an organization may provoke hostility because of the cultural unacceptability of questioning or doubting older people or unwittingly crossing tribal barriers.

A need for what Bell and Wood-Harper (1993) call "analytical honesty" exists - a realisation that local perceptions will differ from those of the originator nation or organization, and that the typical mechanistic or "hard" model favoured in developed (especially Western) nations are inadequate at expressing the real needs of developing nations. Furthermore, Knight (1993) points out that the mere concept of information and the value it holds for an individual, may differ from society to society, thus hindering rather than aiding the introduction of information technology.

5 *Satisfying fundamental human needs should drive the introduction of information technology in developing countries.*

In terms of Human Scale Development (Max-Neef, et al., 1989) information technology is an enabler of education and training, basic literacy skills, communication, socialisation in the sense of abilities of being electronically together, self-actualization, labour mobility and dissemination of basic information to enhance living conditions. In contrast, developing countries often try to emulate the productivity increases reaped by developed countries through 'computerization'. War stories abound of how such emulations have turned into financial quagmires. Yet the scenarios continue to be replayed, to such an extent, in the words of Cotterman and Malik (1993), the result *"has been an awkward overlay of advanced industrialized technology on an unreceptive host"*.

6 *No nation shall exclusively retain unfair advantage over other nations by making it impossible for them to obtain training and experience opportunities for their workers except in so far as this could infringe on any proprietary information rights.*

Since it was first acclaimed, perhaps by Warren McFarlan, to be a 'competitive weapon', information and information systems are routinely touted as tools to achieve comparative advantage and retain competitive positions. This very definitely implies I-win-you-lose strategies which, in the integrated and connected world of today, makes less and less sense. The strategy of long-term thinkers in the field are much more aimed at win-win options, realising that there are places in the sun for everyone. In the long-term, the

survival - indeed, the economic and socio-economic health - of Third World countries are in the best interests of the developed world. A future in which the poor simply become poorer is, the world has to accept, too ghastly to contemplate.

7 *Information technology shall not be mindlessly promoted as a panacea for all problems of organisations and societies.*

There is overwhelming evidence of the absurd ends to which, not only suppliers, but international development agencies and idealists go to promote a utopia in which information technology delivers the wonders of economic bliss and democratic freedom. There are well-argued refutations of this nonsense (see, for example, Berman (1992), Postman (1992) and Bolter (1989)). The problem is not so much that the 'mindless promotion' is based on a naive understanding of the complexities involved in the development process, but that such misplaced hopes are created for instant solutions to deeply rooted problems. In the process huge financial investments are misguided and the possibilities of real development discredited.

8 *The application of information technology in underdeveloped countries shall be based on the tenet that economic and socio-economic development go hand-in-hand.*

This implies that the capabilities of information technology to provide socio-economic upliftment in underdeveloped countries, apart from economic benefits, should be exploited. The development process as described by Todaro makes it abundantly clear that neither economic development nor socio-economic development can proceed independently. Yet, as has been stressed repeatedly in this paper, the prophets of information technological progress continue to believe to a very large extent in the rational process of improved decision making, improved efficiency, and tangible benefits as the basis for all information technological intervention.

9 *All developing countries should have an appropriate national information technology policy.*

A recommendation made at the Information Technology in Support of Economic Development Conference (Cotterman & Malik, 1993) was that "*all governments (of developing countries) (should) utilize to its fullest extent and .... take all possible steps to increase the effectiveness of that technology within their national borders ....*" It would seem that the creation of IT infrastructures and IT awareness, necessary for successful diffusion of IT, simply requires (at least in developing countries) a particular well-planned intervention by government. Such intervention should decidedly not infringe on the privacy and decision-making abilities of the individual, and should be driven by satisfying basic human needs, whilst not ignoring the possibilities for economic development through people empowered by information.

6. Conclusions

These additions to the proposed Bill of Rights should now be debated by the international information community. It would certainly be naive to believe that this Bill would be able to overcome negative effects (from the perspective of the developing countries) of market forces, where First World technological imperatives are often seen to receive priority over any 'neohumanist' considerations.

Our additions to the Bill of Rights argue the case for the developing countries, which we found lacking in the original Bill. Clearly, developed countries would not, because a particular clause exists in the Bill, necessarily alter their behaviour towards developing countries. The latter, however, being sensitized by the issues probed in our analyses should be able to see clearer how, in their interaction with developed countries, certain pitfalls and inherent dangers of technology transfer and infusion could be avoided.

We realise that it could be argued that this Bill, in its transformed format, is not any more a Bill of Rights for the Information Age but rather a set of guiding principles for information technology policy formation for developing countries. Be it as it may, we regard the augmented document now to be closer to Glastonbury and LaMendola's (1989) ideal that the Bill should be "*.... the entitlement of all people of whatever country*".

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Upgrading telecommunications infrastructure for fast IT diffusion: Brazil's challenges

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Abstract
Brazil's erratic economic growth in the nineteen eighties has taken its toll on the telecommunications infrastructure. Although investment in telecommunications infrastructure has recently recovered, quality of data and voice transmission is below user's expectations. Therefore, upgrading the Brazilian telecommunications infrastructure in order to meet increased demand from IT users requires new ways of interaction between the public and the private sector, defined by an IT diffusion policy.

1. Brazil's telecommunications sector and its challenges

Brazil's telecommunications sector today is controlled by the Telebrás system, created during the seventies. This system consists of a holding company, 26 state carriers and Embratel, a company in charge of interstate and international calls. The state carriers were created during the sixties when the government recognized the strategic importance of the telecommunications sector. Each state in Brazil has one carrier, which were formed by acquisition and mergers between private and public companies that used to provide local services. Telebrás employs about 100,000 people, has an yearly turnover of $7.8 billion, and has grown since its creation at an average yearly rate of 11 per cent (Wajnberg, 1992).

The Telebrás system raised the telephone density rate (lines per 100 habitants) from 1.75 in 1962 to 5.9 in 1986 and 8.4 in 1993. The present rate is similar to those of Mexico (6.9 in 1990) and South Africa (9.3 in 1990). Public telephones have a significant rate (1.60), comparable to some developed countries. In spite of this increase, the way the carriers were created - acquisition of other companies - led to large discrepancies in the quality of services provided that still exist today. An index built by Telebrás, based on congestion of interstate lines, velocity to repair phones, quality of phone repairs and waiting time to complete a call shows a difference of 42 per cent between the best and the worst carrier (Patury, 1994). There are also large differences in each carrier operational results: in 1992, only 9 out of the 28 Telebrás' companies made profits and only one third had positive returns on sales. State telephone density rates reflect not only differences existing between the poor north-east region and the richer regions (see table I), but also differences between urban and non-urban areas. Telephone density rate in large cities like Rio de Janeiro and Sao Paulo is around 16.1, almost double the density for other regions. The lowest density rate is that of the Maranhao state (1.92). Finally, distribution of lines follows the concentrated pattern of revenue distribution. While 95 per cent of homes with a monthly income of over $1,000 have a telephone, for poorer homes this ratio is only 15 per cent.

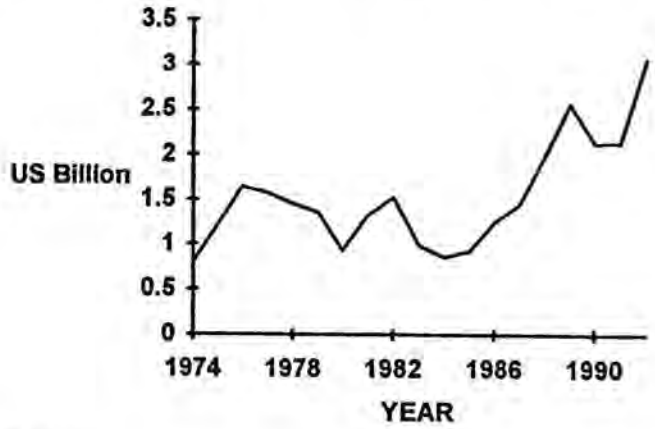
Table 1: Brazil's telephone density rate (lines per 200 habitants)

State	Telephone density rate
Distrito Federal (Brasilia)	21.00
South-east	9.27
South	7.11
North	5.76
North-east	5.59

Source: Jornal do Brasil, 1992

So, the first challenge Brazil faces concerning its telecommunications sector is: how to reduce discrepancies inside the system and increase overall quality?

Resources destined to the telecommunications sector began to fall after 1976 when Government gave priority to other strategic sectors. Telebrás' funding situation deteriorated further between 1982 and 1986 when tariffs were controlled to fight inflation, and taxes on state enterprises were raised (see graph 1). As a result, while traffic grew 1512 per cent between 1973 and 1992, Telebrás' revenues grew only 1,080 per cent.



Source: Telebrás

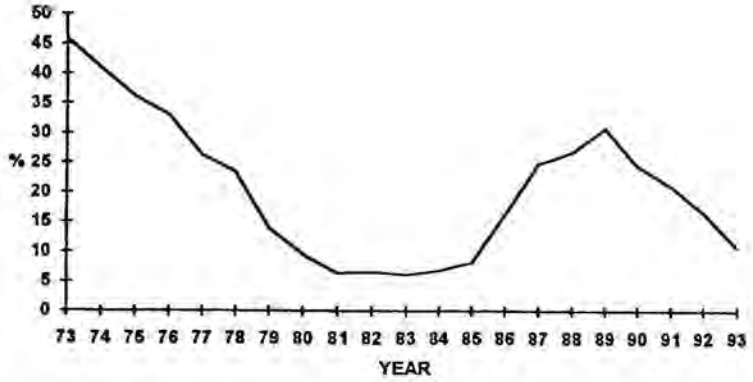
Graph 1: Yearly investment of Telebrás (bl.$)

After 1986, Telebrás managed to raise its revenue by increasing the share of its own resources in the investment from 13 per cent in 1974 to 64 per cent in 1992 (DIEESE, 1994). This was possible because Telebrás charges a large fee for new users: instead of leasing the lines as in other countries, in Brazil users buy the lines at a cost of $2,000. On the other hand, the telephone charge per month is among the lowest in the world. However, this does not mean that Brazilian users always pay less for monthly use, since Telebrás has a cross-subsidy practice that overcharges interstate and international calls in favour of local calls.

The decline of investment between 1982 and 1986, coupled with a growing demand for telecommunications services, impaired the quality of lines (see graph 2). In addition, the high cost of buying a line leaves Telebrás' revenues more sensitive to recession since it is easier for new users not to buy new lines than to reduce the use of telephones. Low monthly charges also leave Telebrás with 95 per cent of monthly revenue dependent on use, while in other countries this ratio is 65 per cent.

Telebrás' capacity to keep up with demand is thus questionable. According to Wajnberg (1992), the present level of investment - $3 billion per year - is sufficient to provide 700,000 voice terminals per year. Since Brazil already has 11 million terminals, and demand by the year 2000 is estimated to be 28 million, there will be a deficit of terminals in case investment continues at the present level. It is difficult to assess investment provision in telecommunications since technology is evolving fast and there are many choices involved. Embratel's technicians, for instance, argue that the present level of investment is sufficient if the aims of provision of telephones is changed. If the aim is to provide one line per home, the present investment is insufficient. However, if the aims were to provide one line per building, or per group of homes coupled with modern switching stations, the investment would be sufficient.

Therefore, the second challenge Brazil's telecommunications sector faces is: how to keep up with the demand of services?



Ratio for developed countries: 6%
Source: Telebrás

Graph 2: Ratio of interstate calls not completed (%)

Finally, Brazil faces another challenge concerning regulation of telecommunication services. Although a telecommunications code was established in 1962, the Government has - ever since then - been devising new laws whenever new individual services are created. Since the role of the telecommunications sector is not an object of consensus within the Government, politicians have preferred to refrain from revising the telecommunications code. This has created a maze of laws and regulations: between 1986 and 1992, 105 new laws were created. In addition, the new Constitution of 1988 led to different interpretations concerning its telecommunications section. Consequently, the line that divides public from private services is not clearly defined at present.

As a result, private companies in Brazil today can provide only a limited range of telecommunication products and services, such as:

1 switchboards for buildings;
2 maintenance of public lines;
3 paging systems;
4 engineering services;
5 satellite channels (only if authorized by Embratel);
6 operation of data networks and satellite systems (with lines or channels leased from Embratel); and
7 value-added services (with lines leased from Embratel).

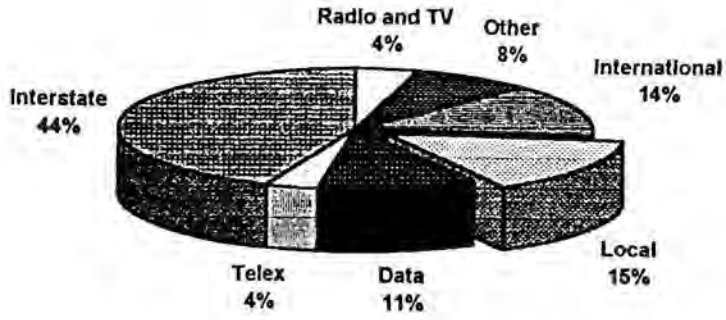
Private companies are lobbying for more opportunities, and sometimes get involved in court fights with Telebrás concerning provision of a given service. On the other hand, most politicians refrain from giving private companies an increased role either because they consider telecommunications a strategic sector or simply because they have political connections with Telebrás or the local carriers.

Therefore, the third challenge Brazil faces is: how to define public and private provision of services in a sector where regulations are not clear? These challenges represent today a serious obstacle to IT diffusion as will be shown in the next section.

2. Telecommunications infrastructure and IT diffusion

The technological convergence between telecommunications and informatics, on one side, and telecommunications and radio diffusion, on the other, has two main implications. The first is that telecommunications infrastructure is increasingly important for IT diffusion through data networks (WAN's and LAN's) which are growing at a fast rate in large firms (Bar, 1990). The second is that the technological trajectory of information technologies has a growing range of possibilities, so the definition of a policy for IT diffusion is complex.

In Brazil the diffusion of data networks is also led by large firms of the services and the industrial sectors (La Rovere, 1994; Tauile & Fagundes, 1994). The main users of telecommunication services are firms of the services sector whose activities are of high information content. Data transmission is already an important source of income to Telebrás (see graph 3), and its importance is growing.



Source: Dieese

Graph 3: Composition of Telebrás Revenues

Although the use of radio diffusion techniques in provision of networks is possible, and already adopted by some Brazilian private firms, deficiencies in the telecommunications infrastructure are regarded by firms as a serious hindrance. The obstacles to network diffusion also hamper diffusion of value-added services because firms tend to increasingly rely on a few providers to attend to all their informational needs.

Besides, IT diffusion depends on the organizational culture which in most Brazilian firms is poor due to the difficulties involved in setting up a network.

According to recent research on obstacles to IT diffusion in Brazil (La Rovere, 1994), the major obstacles identified by firms were:

1 inadequate telecommunications infrastructure;
2 lack of resources for investment;
3 high cost of transmission channels;
4 high cost of equipment;
5 inadequate technical assistance; and
6 lack of organizational culture.

By 'inadequate telecommunications infrastructure' users mean congested lines, which are common in urban centres, and the inefficiency that results from the division of attributions inside the Telebrás system. For instance, to set up a data network a firm has to deal with Embratel and the carriers of the states that will be covered by the network. Embratel claims that about 70 per cent of the pending contracts in 1992 were in this situation because of local carriers. As a result, the waiting time for having a new service can be up to 180 days, if not more. High cost of transmission lines results from the cross-subsidy policy mentioned above. Telebrás is at present reviewing this policy as large users of Embratel complain about its costs. High cost of equipment stems from producer concentration, while inadequate technical assistance is linked to deficiencies in technical training in Brazil. Finally, the lack of organizational culture is linked to the deficiencies in training and also to the inadequacy of the infrastructure: many companies, specially small firms, fail to perceive the opportunities presented by IT diffusion given these problems.

Users try to overcome these obstacles in different ways according to the size of the firm and the number of users. Large firms are more concerned with quality and velocity than with costs. These firms then start making use of satellites and set up private networks. Medium sized firms appeal to network sharing. Small firms have few options and complain that they are discriminated against by Embratel and the carriers. In effect, our research found that for these users the waiting time for access to services was greater. The private networks used by large firms are based on different systems which means that their capacity to interact with other large firms is limited. Thus, Brazilian firms tend to a fragmented model of data communication that will impair their competitiveness on the long run. At a time when most countries are discussing information highways, Brazilian firms seem to be building several secondary roads.

Telebrás is planning to solve the fragmentation problem by building an optical-fibre network that will link all state capitals and provide connections to the rest of the world. Nevertheless, this will create another dilemma linked to the definition of an IT diffusion policy. As mentioned earlier, the present telecommunications infrastructure in Brazil provides services mainly to the rich minority of the population and to large companies. Therefore, simply upgrading the telecommunications infrastructure does not necessarily insure that social needs will be met. If no measures concerning access to the optical-fibre network are defined, the new network will only increase the gap between large and small companies, as well as rich and poor users.

3. Conclusion: the need to define an IT diffusion policy

The challenges involved in upgrading the telecommunications infrastructure make the need to define an IT diffusion policy urgent. The first step to define this policy would be to reform provision of telecommunications service. First, a revision of the Telecommunications Code, and of the laws regulating the sector, is needed. This revision should define the role of the State and of private companies in the telecommunications sector so that the offer of telecommunications services could increase. However, while a clear division of roles can meet users' demands, it still does not provide a solution for financing the Telebras system. De-regulation or privatization of the telecommunications sector is being considered, by the recently elected President, in order to raise funds. This process would have to be strongly controlled to guarantee reduction of regional disparities and to meet social demands. However, considering the composition of the newly elected Congress, such a control will be very difficult to undertake.

Second, a reform of state companies in the telecommunications sector is also needed. State companies today are bound by employees' stability, strict procurement practices and tariff policies that go against their efficiency. A competitive environment in the provision of advanced telecommunication services would force Telebrás' companies to be more aggressive in providing services to new users. Third, Telebrás should also consider how to best meet basic needs, such as telephone access, by examining alternative ways provided by technological advances in the telecommunications sector to try to guarantee access to information to the poor.

Overall, the scenario for IT diffusion among Brazilian firms is one where each firm will look for its specific network solutions thus reducing its own possibilities of collaboration with other firms. This scenario goes against the requirements of production flexibility and subcontracting, implicit in the present industrial organization paradigm (Bar et al., 1987). Therefore, the second step for stimulating IT diffusion would be the definition of standards so that fragmentation of networks would be reduced.

The third step to stimulate IT diffusion is to enhance training inside firms, as well as support sharing of experiences between firms, so that lack of organizational culture and poor technical assistance cease to be problems.

Finally, a policy supporting IT diffusion in Brazil could focus on small firms - which are socially important given their capacity to absorb workers - and extend IT diffusion to social areas like health and education. This step would cater to people that are traditionally excluded from the benefits of technical progress.

The measures discussed above presupposes that the Government is strongly committed to reform in its telecommunications sector, which will not be the case if the political coalition that supported the election of the new Government prevails. Instead, this group favours privatization of the telecommunications sector and little State intervention. If this happens, IT diffusion in Brazil will continue to be fragmented as before, and it will benefit only a minority of the population and companies.

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