

**Shaping Technology across Social Worlds: Understanding
Learning Dynamics in Implementing computerised IS in the
Ethiopian Public Health System.**

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***Submitted as partial fulfilment of the requirements of the degree of Doctor of Philosophy
(PhD)***

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November 2009

To my wife Sofia Lulesaghad and my son Elnathan Shegaw who brought meaning to my life!!!

Acknowledgements

What counts for learning in general, is also true for writing this thesis. It is not just the final product that counts; it is mainly the process of learning and interacting with many people that has enriched my experience and enhanced my 'interpretive schemes' on carrying out research. Looking back on the last five years, the main feeling now is that the whole process was rewarding and it was all for the best. Many people walked in to my life, and I am very grateful to all those who contributed. I hope that for them the finalizing of this work is a reward in itself, since I cannot thank all of them sufficiently here in person. There are, however, some people whom I want to mention specifically, for one reason or another.

I am deeply indebted to my first supervisor Professor Margunn Aanestad who has been an inspiring coach in getting me through the challenging process of completing a PhD. Thank you so much for your intellectual generosity, critical and insightful comments, your encouragements and always finding the time to assist me whenever I needed it. I am also grateful for my second supervisor Professor Sundeep Sahay for his intellectual support especially at initial stages of writing this thesis.

I would like to use this opportunity to express my heartfelt gratitude to professor Per Ekelund for his generosity, care and hospitality when I arrive in Norway for the first time and for his invitation and the wonderful time that me and my colleagues had in his hometown Aalesund. I am also grateful to Professor Jørn Braa and his wife Unni Johannessen for their encouragement and support over the years. I also extend my gratitude to Petter Nilesen for his academic support and for being a good friend to me during my stay in Norway. I am grateful that you introduced me to the Norwegian lifestyle in many ways. I am also thankful for the moral and emotional support I received from Girmachew, Mahlet, Bahiru, Gebre, Gebre, Abdu, Birhanu, Hailu, Kinfe, Kibur, Yaregal, Ethiopia, Hirut, Teklu, Edna, and Teshome.

I also got support from different institutions and individuals while I conduct my field work in Addis Ababa, Amhara and Benishangul-Gumuz regional states. I am grateful for the support I got from the management team, health workers and statisticians in each respective regional state. I owe special thanks to Zufan, Tadele, Dr. Zewditu, Said, and Dagim whose companion, friendship and support make my stay in the field easier.

I also extend my sincere thanks to Dr. Prodrmos Tsiavos and Dr. Christina Mörtberg for volunteering to review and comment on the draft of this thesis. Their valuable comments and suggestions had significantly contributed in improving this work. For this I owe them my gratitude. I also would like to extend my gratitude to former and current members of the global infrastructure group for their encouragement and support in one way or another; from Ethiopia (Abiot, Birknesh, Desalegn, Nigussie, Solomon, Zegaye, Zufan), from Mozambique (Emilio, Leopoldo, Humberto, Gertrudes), from Norway (Ola, Knut, Lise, Jøhan, Espen), from South Africa (Vincent and Louisa), from Tanzania (Honest, Lungo, Faraja), and from Malawi (Chipo). I am also grateful to the faculty members of the global infrastructure and design group: Professor Ole Hanseth, Professor Jens Kaasbøll, Miria, and Maja for their encouragements and valuable discussions during group meetings and workshops.

I am grateful to the financial support provided by the Royal Norwegian Embassy in Addis Ababa to cover my cost of living as well as travel expenses for my field work and to

participate in international conferences. I am also grateful to the administrative and academic staff at the institute of informatics (IFI), University of Oslo, for providing me the necessary facilities and conducive working environment to conduct my research. My special thanks go to Anne Cathrine Modhal and Lena korsnes for being kind and supportive whenever I need their help.

Last but not least, I owe a great deal of gratitude to my family members. My wife Sofia has been an inspirational wife by being in my side in all the challenging years of writing this thesis. She took all the burden of motherhood and taking care of all household issues and gave me the freedom to focus in my writings. Her encouragement, love, care, and all rounded support had helped me to successfully complete the PhD program. Little Elnathan, thanks for always keeping me warm in your love!! My special thanks goes to my father, Anagaw Mengiste and my mother, Nitsueh Tariku who believed in my dreams and encouraged and supported me to pursue the challenging academic life. I am also deeply indebted to my mother-in-law, Ms. Almaz Asmelash for her support in taking care of my baby and her emotional encouragements to me and my family over the years. I also extend my warmest gratitude to my sisters and brothers (Woubsira, Yalemzewd, Addis, Muluken, Selam, and Rahel), my sister-in-laws and brother-in-laws (Aklilu, Eden, Biruk, Abiy, and Maedot) for their love and moral support. Big thanks also for my family members in US; Temesgen, Asmamaw and their families for giving me and my family a few weeks off from the hectic academic work and for their kind and brotherly hospitality.

Shegaw Anagaw Mengiste
Oslo, Novemeber 2009

List of abbreviations and acronyms used

AAHB	Addis Ababa Health Bureau
ADLI	Agricultural Development- Led Industrialization
DDN	Digital Data Network
DHIS	District Health Information Software
EPRDF	Ethiopian People's Revolutionary Democratic Front
ESDP	Educational Sector Development program
ETC	Ethiopian telecommunications Corporation
FDRE	Federal democratic Republic of Ethiopia
FY	Fiscal year
GDP	Gross Domestic product
GPRS	General Packet radio Service
HIPDT	health Information Processing and Documentation Team
HIS	Health Information System
HISP	Health Information Systems Program
HIV/AIDS	Human Immune Virus/ Acquired Immune Deficiency syndrome
HMIS	Health Management Information System
HSDP	Health Sector Development Program
ICD	International Classification of Diseases
ICT	Information and Communication Technology
ICTDA	Information and Communications Technology Development Agency
IMF	International Monetary Fund
IP	Internet Protocol
IS	Information System
ISP	Internet Service Provider
LC-FRD	Library of Congress- Federal Reserve Division
MCH	Maternal and Child Health
MoFED	Ministry of Finance and economic Development
MoH	Ministry of Health
MoI	Ministry of Information
NAC	National Advisory Committee
NORAD	Norwegian Agency for Development
OL	Organizational Learning
RHB	Regional Health Bureau
TB	Tuberculosis
TGE	Transitional Government of Ethiopia
UNDP-HDI	United Nations Development Program- Human Development Index
UNECA-ADF	United Nations Economic Commission for Africa- African development Forum
UNICEF	United Nations Children's Fund
VSAT	Very Small Aperture Terminal
WHO	World health Organization

Table of Contents

Acknowledgements	ii
Table of Contents	v
List of Tables	vii
List of Figures	vii
PREFACE	viii
ABSTRACT	ix
CHAPTER ONE	1
1.1 Introduction	1
1.2 Research Motivation	3
1.3 Theoretical Basis: Overview	10
1.4 Overview of Empirical Basis and Research Approach	13
1.5 Expected Contributions	15
1.5.1 Theoretical.....	15
1.5.2 Practical	16
1.6 Structure of the Thesis.....	16
CHAPTER TWO	17
Research Setting, Approach and Methods	17
2.1 Research Setting and Context	17
2.1.1 Historical and Political context	17
2.1.2 Geographic and Demographic Context	19
2.1.3 Socio-Economic Context.....	21
2.1.4 Education and Literacy.....	23
2.1.5 ICT Initiatives	24
2.1.6 The Health Sector Context	26
2.1.7 Health Information System (HIS) in Ethiopia.....	28
2.2 Research Approach and Methods.....	33
2.2.1 Approaches in IS research	33
2.2.2 The Interpretive Research Approach.....	34
2.2.3 Research Design and Methods	36
CHAPTER THREE	48
Conceptual Framework	48
3.1 Organizational Learning: Debates and Approaches.....	48
3.2 Acquisition vs. practice-based perspectives of Learning	52
3.2.1 Acquisition Perspective of Learning	53
3.2.2 Practice-based Perspective of Learning	55
3.2.3 The ‘Third Way’ as a new perspective to Learning	59
3.4 HIS development and implementation as negotiated order.....	64
3.4.1 How Learning helps to deal with the challenges of installed base cultivation, scaling, and sustainability	75
CHAPTER FOUR	79
Presentation and Analysis of Findings	79
4.1 Research Articles included in the Thesis	79
4.2 Synthesis of Findings and their Inter-linkage	92
4.2.1 Tensions and conflicts within and between social worlds (sub-worlds) as drivers for learning.....	93
4.2.2 Summary of Findings in terms of the research questions posed	104

CHAPTER FIVE	105
Research Contributions and Concluding Remarks	105
5.1 Theoretical Contributions.....	105
5.1.1 HIS development and implementation as negotiated order across social worlds .	106
5.1.2 The relation between learning and the notions of installed base cultivation, scaling, and sustainability.....	108
5.1.3 Implications for Information systems (IS) Research.....	117
5.2 Practical Implications	119
5.3 Limitations of the study.....	124
5.4 Concluding Remarks	126
REFERENCES	128
APPENDIXES	141

List of Tables

Table 2. 1: <i>Methods of qualitative Research (Source: Silverman 2001, p.90)</i>	39
Table 2. 2: <i>Distribution of interviewees across settings and their position</i>	42
Table 3. 1: <i>Three Perspectives of organizational learning</i>	63
Table 5. 2: <i>Examples of challenges and context-sensitive strategies</i>	123

List of Figures

Figure 2. 1: <i>Map of Ethiopia and its location in the horn of Africa</i>	21
Figure 2. 2: <i>HISP pilot sites in Ethiopia</i>	30
Figure 2. 3: <i>Data flows and the level of DHIS implementation in three regional states</i>	32
Figure 2. 4: <i>Pictures from the field work</i>	44
Figure 3. 1: <i>A model of interacting social worlds in HIS development</i>	66
Figure 5. 1: <i>The Interplay between learning and the notions of installed base cultivation, scaling & Sustainability</i>	110

PREFACE

This thesis is submitted as partial fulfilment of the requirements for the Doctor of Philosophy (Ph.D) at the Faculty of Mathematics and natural Sciences, Department of Informatics, University of Oslo, Norway. The research was funded by the PhD project of Norwegian Embassy in Ethiopia which sponsored my subsistence allowance in Norway and travel costs for field work in Ethiopia and conference participation costs. This thesis comprises five introductory chapters and five scientific papers that are included as appendixes. The papers that are included as appendixes are listed as follows:

- I. Mengiste, Shegaw A. (2005). Challenges and opportunities of Implementing District-based Health Information System in Ethiopia: A Case Study from Benishangul-Gumuz Region. In Bada, A. & Adalakun, O. (eds.). *Proceedings of the IFIP W.G 9.4- Working conference on enhancing human resource development through ICT*. Abuja, Nigeria. pp. 256-267.
- II. Shaw, V.; Mengiste, Shegaw A.; Braa, J. (2007). Scaling of Health Information Systems in Nigeria and Ethiopia- Considering the options. In: Silva, L; Westrup, C. and Reinhard, N (eds.). *Proceedings of the IFIP W.G 9.4 on social implications of computers in developing countries*. Sao Paulo, Brazil.
- III. Kimaro, Honest C., Mengiste, Shegaw A. & Aanestad, M. (2008). Redesigning Health Information Systems in Developing Countries: The Need for Local Flexibility and Distributed Control. *Journal of Public Administration and Development*, 28: pp. 18-29.
- IV. Mengiste, Shegaw A. (2009). Analysing the challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies. *Journal of health informatics in Developing Countries* (Under Review).
- V. Mengiste, Shegaw A. & Aanestad, M. (2009). Understanding the Dynamics of Learning Across Social Worlds: A Case Study from introducing IS into the Ethiopian public health care system. *Information and Organization* (revised and re-submitted).

ABSTRACT

This thesis aims to address the challenges of successfully implementing, scaling and sustaining ICT interventions in developing countries. The thesis argues that an effective learning process is crucial for successful IS development and implementation. In this thesis, the focus is on understanding the dynamics of learning in IS projects with a specific orientation to the need for mutual learning among members of different social worlds. Theoretically, the work draws on recent attempts to bridge the practice-based and cognitive accounts of learning, based on the concepts of negotiated order and social worlds from Anselm Strauss. Empirically this is studied in the context of a project aiming to introduce a computerised Health Information System in Ethiopia, where IS developers and public health domain experts collaborated. Specifically, the thesis seek to explore how tensions and conflicts may trigger learning among different stakeholders within and between multiple social worlds. This thesis describes HIS development, adaptation and implementation as a complex and dynamic process of change that involved the interaction, communication and negotiation of several stakeholders from different social worlds with varying interests, commitments, and values. Through the negotiated order of specific learning arenas, diverse stakeholders interacted, communicated and negotiated on a number of problems and issues including: data collection and reporting tools, existing work practices and routines, the application of computerised system to improve existing practices, and type of skills and knowledge required to develop and sustain the system. Taking an interpretive approach, the researcher has documented the learning process through semi-structured interviews, informal discussions and interactions participant observation during meetings, discussions, workshops, seminars, and trainings, as well as document analysis (including official reports, strategic documents, memorandum of understandings, and e-mail conversations). The thesis contributes by introducing a new theoretical lens for conceptualizing HIS development as a process of learning across social worlds. This approach is useful as it improves our understanding of the role of learning in relation to the challenges of scaling, sustainability, and installed base cultivation.

CHAPTER ONE

1.1 Introduction

This thesis adopted a learning perspective to analyse the dynamic process of knowing and learning in developing and implementing computer-based information systems (IS) in the context of the Ethiopian public health care system. For the purpose of this thesis, learning is regarded as an ongoing social process that involves reflection and action, seeking feedback, experimenting, interacting and negotiating to deal with tensions and problems in everyday organizational life and work (see Edmonson 1999; Elkjaer 2003; Nicolini and Meznar 1995). This thesis also acknowledges that individual cognition and thinking is instrumental to social process of learning. Learning, is therefore, understood as a way of being and becoming part of the social worlds¹ that comprise multiple organizational actors (Elkjaer 2003).

While the need for learning during various phases of the IS development and implementation process is generally recognized, the IS literature on this topic appears diverse and fragmented. Scholars (such as Huysman 2000; Pirinen and Pekkola 2006) pointed out that the IS literature often give emphasis on some aspects of learning while ignoring others. For example, the literature is fragmented in the way it addresses issues related to who is learning (units of analysis), what is learnt (the content of learning) and how one learns (learning mechanisms).

With regard to the units of analysis, there is disagreement on the issue of whether the individual, group or organization learns. Scholars (such as Robey et al. 2000; Stein & Vandenbosch 1996; Lyytinen & Robey 1999) for example, emphasize on organizational level of learning where as others (such as Newman & Nobel 1990; Majchrzak & Beath

¹ Social worlds “are groups with shared commitments to certain activities, sharing resources of many kinds to achieve their their goals, and building shared ideologies, about how to go about their business” (Clarke 1991 pp. 131 citing Strauss 1978).

2000; Zong & Majchrzak 2004) promote individual or group level learning. There are also IS scholars (such as Curtis et al. 1988; Huysman 2000) who treat learning as a multi-level process that occurs at individual, group and organizational levels.

Regarding the learning mechanisms, some IS scholars focus on the acquisition of skills and knowledge in a form of formal education, training and instruction (see for example Walz et al. 1993; Ang et al. 1997, He 2004; Mathiassen & Pedersen 2005); while others emphasise on the importance of collaboration, negotiation, actions, and interactions between different stakeholders as mechanisms to learning (see Majchrzak & Beath 2000; Huysman 2000; Majchrzak et al. 2005). Regarding the learning content, there are also differences among IS scholars. Some evaluate learning in terms of its outcome based on changes on individual mental models (Zhong & Majchrzak 2004) or changes on organizational routines (Stein & Vandenbosch 1996); while others treat it as a process whereby different actors know and learn through their participation in the physical and social world (Elkjaer & Huysman 2008; Antonacopoulou 2006).

The process of adapting and implementing computer-based IS in the context of developing countries is a complex and dynamic process of change (see Braa 1997; Braa et al. 2004). The complexity is partly explained by the involvement of diverse stakeholders, multiple institutional practices and complex activities and tasks. Due to the complexity of work practices, diversity of the involved actors and their differences in commitments, interests and values; there are always tensions and conflicts while introducing change in such contexts. These tensions and conflicts are addressed through ongoing interaction, communication and negotiation processes whereby different stakeholders learn from each other.

This thesis, therefore, adopted the social worlds perspective to understand the learning dynamics by exploring the tensions and conflicts that trigger learning among different stakeholders across different social worlds of IS professionals and public health domain experts by drawing empirical examples from the global Health Information System

Program (HISP) initiatives of adapting and implementing district-based health information system in the context of the Ethiopian public health care system.

1.2 Research Motivation

“As we begin a new century the promise of good health for the people of developing countries seems far from reality. Although greater strides have been made over the last century in preventing diseases and extending life in the developed world, the situation in developing countries remains bleak. Life expectancy in most developing countries has declined below that of 1960s. Developing countries are facing a continuous health threat characterized by ravaging epidemics, spread of infectious diseases, high level of infant and maternal mortality, low levels of life expectancy and deteriorating health care services and facilities”(UNECA- ADF 2000 pp. 1).

As it is clearly indicated in the above quote, initiatives to reform the public health care system of most developing countries has been threatened by new and old challenges. In most developing countries, the main causes of mortality and morbidity are old (TB, Malaria, diarrhoea/cholera) and new (such as HIV/AIDS) communicable diseases combined with diseases of lifestyle (e.g. hypertension, diabetes) and diseases linked to the environment and/or poverty (Braa & Blobel 2003). In Africa, for example, “close to 1 million deaths occur every year due to malaria alone. Twenty two million of the 33.4 million people infected with HIV/AIDS live in sub-Saharan Africa. More than 8 million children have been orphaned by this epidemic” (UNECA-ADF 2000 pp. 1-2). Besides, maternal and child mortality as well as vaccine preventable diseases needlessly claim millions of lives each year (WHO-HMN 2008). The challenges of delivering health care services in developing countries is also further exacerbated by inadequate resources and limited capability at a local level.

To deal with the new and old challenges, developing countries in collaboration with international organizations (such as WHO, UNDP) and donor agencies (such as World Bank) have long been engaged in public health sector reform initiatives including:

decentralization of health care delivery and management, integration of different vertical health programs, strengthening of management practices, and the introduction of information and communication technologies to support and strengthen the routine health management information systems (HMIS) (Lippeveld et al. 2000).

The importance of strengthening the routine health information systems (HISs) has been well recognized by international organizations, aid agencies and national governments as one approach to support the public health reform initiatives of developing countries. More specifically, the Alma-Ata declaration of 1978 set out a new approach leading to the development of health information systems most commonly seen in many developing countries today. The Alma-Ata (1978) conference emphasised on the importance of well-designed and well-functioning routine health management information system as an essential mechanism to achieve the vision of improved health services delivery in developing countries (WHO 1994) by allowing policy makers, managers and health workers to “identify problems and needs, track progress, evaluate the impact of interventions and make evidence-based decisions on health policy, programme design and resource allocation” (WHO-HMN 2008, pp. 6). Lippeveld et al. (2000) also noted that “the development of rationally structured routine health information systems, closely adapted to the information needs of health services at the district, health centre, and community levels, can potentially contribute to the overall improvement of health service management” (ibid pp. 2).

Recognizing the importance of strengthening routine health management information systems for better health care delivery and management; there have been tremendous reform initiatives by many developing countries including Ethiopia, an “initiative spurred in large part by technological advances, and the interest these advances have generated in the health sector” (Vital Wave Consulting 2009, pp. 14). For example, there is growing recognition that ICT can replace traditional routine paper-based HISs with flexible electronic means and could bring significant cost reduction and effectiveness in terms of timely delivery of health care services in developing countries (see Mackenzie 1999, Braa and Hedberg 2002; Braa et al. 2004; Braa et al. 2007a).

However, despite the widespread efforts to strengthen HIS reform initiatives through ICTs in many developing countries; several scholars (see Braa et al. 2001; Avgerou & Walsham 2001; Sahay 2001; Braa & Hedberg 2002; Sahay & Avgerou 2002; Heeks and Baark 1999; Avgerou & Walsham 2002; Heeks 2002; Avgerou 2007) reported that attempts have so far yielded ineffective results, leading to systems remaining as unused pilot systems that fail to live after the donor-based funding has ceased. Several reasons have been attributed to such lack of success. For example, Sahay and Avgerou (2002) identified two interrelated problems: difficulties in nurturing and cultivating complex technology projects over the long periods of time; and the little impact of the computer-based systems in improving organizational efficiency and effectiveness. The significant involvement of donor agencies and the dependencies that creates in the host nation, poor infrastructure (both physical and digital), and the inherent complexity of the HIS are also identified as reasons for the poor performance of ICT based HIS reform initiatives in developing countries (Mosse and Sahay 2003; Sahay 2001; Braa et al. 2001; Heeks and Baark 1999). Braa et al. (2007b) also indicated that “a complex tangle of local and national requirements with often dismal infrastructure, stifling bureaucratic inertia, limited local IS capacity, and severely scarce resources” (ibid no page) are the factors influencing the realization of improved HIS in most low income countries.

Several theoretical explanations have been proposed to this lack of success in adapting ICT based systems and tools in many developing countries. For example, the literature on “technology transfer” attempted “to emphasise the gap between the assumptions inscribed in the technologies developed in the context of industrialized countries and the prevailing way and state of organizational life in the countries where the technologies were transferred” (Sahay and Avgerou 2002, pp. 73). However, the technology transfer approach itself failed to bring the required results in the context of developing countries mainly due to design-reality gaps (see Heeks 2002; Nhampossa 2006; Lungu 2008) where the developers of the new technology fail to understand the deep rooted work practices and underlying problems of the context of developing countries where the technology is to be implemented and used. In line with this, Nhampossa (2006) emphasized that “...transferring of an application focused technology and related

knowledge becomes problematic, since it involves contextual and cultural elements such as language and meanings, which cannot be transferred, but rather need to be built locally” (ibid pp. 29). The technology and the know-how of using the technology can’t be transferred straightforward, just because the technology and the knowledge does not exist before it is developed locally through the interaction, negotiation, mutual learning, mutual adaptation and ongoing practices of local actors. This requires, in addition to the transfer of technical artefacts (such as HIS application software), learning to take place (Braa et al. 1995) at a local level by the local actors. As such, in this study, I argue that rather than emphasising on technology transfer approaches which have actually failed to bring the desired outcome in many developing countries, IS development and implementation initiatives in resource constrained settings of developing countries should be treated as local and situated learning enhanced through the actions, interactions and negotiations of different stakeholders at a local level.

Why the learning Perspective to IS development and implementation in developing countries?

Several IS scholars have emphasised on the importance of the learning approach to IS development and implementation (see for example Salaway 1987; Lyytinen 1987; Lyytinen and Robey 1999; Wastell 1999; Zong & Majchrzak; Baxter et al. 2009). For example, Baxter et al. (2009) indicated that if an ISD project is to be successful, learning and social interaction is necessary to occur at individual, group and organizational levels. Lyytinen (1987), in his survey of research on information system problems and solutions, also specified on the role of learning based models in IS development and implementation. In his model, he argued IS development and implementation to be treated as social learning where the IS is an incremental outgrowth of this learning, and it continues to evolve over time owing to new learning experiences.

Similarly, in this thesis, I argue that the process of developing and implementing technical artifacts (such as District-based health Information software) or introducing new standards of data collection and reporting, or changing work practices in public health

settings of developing countries (which is characterized by its complexity and diversity) need to give greater emphasis in understanding and exploring learning dynamics as a strategy to harness the potentials of new technologies and systems in their context of use than simply transferring such technologies from North (the context where the system is developed) to South (where the system is to be used). Unlike technology transfer approaches (see Rogers 1995; Odedra 1991), the learning perspective gives emphasis on knowing and learning as dynamic and emergent social accomplishments that are actively situated within specific context of practice (Marshall 2008). The learning perspective adopted in this study (i.e. the social world perspective), as such, gives attention to the social, cultural and organizational context where the system is to be developed and used as well as the complex and dynamic nature of knowledge creation and learning as well as the tensions and conflicts emanating from differences in commitments, interests and values among different stakeholders.

Learning therefore is the result of the interactions and negotiations of different stakeholders representing distinct social worlds and sub-worlds. This interaction and negotiation of multiple actors is mediated by a wide variety of boundary objects² (such as technical artifacts, standards, contracts, training materials etc.). This process is what Strauss (1978) and other scholars (such as Model 2006; Fine 1984; Rahman & Lawrence 2001) described as negotiated order. It is through this negotiated order that tensions, conflicting interests and constantly changing needs and multiple voices of different actors within and between different social worlds are negotiated and mediated. In this process, stakeholders from the different social worlds either reconcile their conflicting views, interests or practices through mutual learning and understanding, or keep their differences for further negotiation. In the context of HIS design and development, the stakeholders could interact and negotiate on diverse issues and problems including: existing standards, data collection and reporting tools, application of computerised system to change existing

² Boundary objects “are objects that inhabit several interesting social worlds and satisfy the information requirements of each of them. As such, they are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites....Such objects are developed over time through cooperation between different groups” (Star & Griesemer 1989, pp. 393). Boundary objects play a significant role in facilitating collaboration across disciplinary boundaries (ibid).

work practices, strategies to scale the system both geographically and functionally, and in building the competency, skill and knowledge of managers, health workers and IS developers and implementers. This is an iterative and on-going process whereby new challenges and issues as well as institutionalized systems, tools, standards, routines and work practices are re-negotiated if there are new challenges, tensions, change or disruption (Strauss 1978, 1984, 1991).

The key motivations for adopting the learning perspective in this thesis, therefore, are two-fold.

1. The public health care system of developing countries is characterised by diversity of stakeholders, fragmented structure, multiplicity of work practices, and scarcity of financial, human and infrastructural resources. In such complex and diverse settings, introducing computer-based information systems and standardization of fragmented data sets and reporting formats requires both individual cognition (including intuition and reflective thinking) of individual actors as well as knowing and learning developed through participation, interaction and negotiation of different stakeholders. For example, individual skills and knowledge on systems development tools and technologies are essential for IS developers and implementers to make a contribution in customizing software or in developing new modules. Similarly, public health domain experts also need to have basic skills and knowledge on epidemiology, health services and programs, health data and indicator analysis. People (individuals or groups) also get new insights, acquire new skills and knowledge in the course of their participation in different activities of introducing change to existing systems, standards and work practices. In such settings, adopting either the cognitive or practice-based perspectives in isolation would be problematic to embrace both the individual and collective aspects of learning as well as the reciprocal and interdependent nature of knowing and learning. For example, the cognitive perspective focuses on individual cognition that is acquired through formal trainings, instruction and education and underestimates the situated and context-dependent aspect of knowing and learning. The practice-based approach, on the

other hand, treats knowing and learning as participation in communities of practice which is an integral part of everyday organizational life and work not as specific, delimited and intentional activity (see for example Nicolini and Meznar 1995).

The social worlds perspective which has been adopted in this thesis is a pragmatic approach that attempts to bridge the gap between cognitive and practice-based approaches by treating learning and knowing both as an individual and collective phenomenon. In the social worlds perspective, the unit of analysis is no longer the individual or the communities of practice, but is to be found in the network of relations in day-to-day organizational life and work practices (see Hagar 2005; Elkjaer 2005). Though individuals always have certain element of personalized skills and knowledge on different issues and topics depending up on their educational background and their exposure to the physical and social world; it is through their on-going participation, interaction and negotiation with other people in every day organizational life and work activities that they develop new insights, skills, knowledge, mutual understanding and mutual learning. As such, adopting the social worlds approach in this study gives me the analytical leverage to examine learning dynamics and explore tensions and conflicts that trigger learning both at individual and collective levels.

2. Over the years we have witnessed so many initiatives of introducing ICT based information systems in the public sector of both developed and developing countries failed to achieve their intended goals partly due to our inability to learn from our previous failure or success stories (see Heeks 2002; Heeks et al. 1999; Scott & Vessy 2000). Studying the process of HIS development and implementation from the learning perspective would give the opportunity to examine past mistakes and experiences, explore learning dynamics at a local level, identify tensions influencing the change process, and formulate context-sensitive strategies to deal with specific challenges and problems based on local experiences, best practices and situated learning.

The principal aim of this study, therefore, is to understand learning dynamics by exploring the tensions and conflicts that trigger learning among different stakeholders within and between different social worlds and sub-worlds in the process of adapting and implementing computerised HIS in public health care institutions of a developing country. The study also aims to examine the role of local and situated learning in dealing with the challenges of installed base cultivation, scaling and sustainability.

To this end, the thesis had the following specific research questions:

- What are the tensions and conflicts that trigger mutual and interactive learning between stakeholders from distinct social worlds and sub-worlds in the process of adapting and implementing computerized HIS in the context of a developing country?
- How does local and situated learning of different stakeholders help to understand and address the challenges of cultivating the installed base of existing HIS as well as scaling and sustaining local interventions over time?

1.3 Theoretical Basis: Overview

To remain viable in today's living and working environment, which is mainly characterized by intensification of globalization, acceleration in the rate of change and uncertainties, and expansion in the use of information technology; organizations and individuals alike depend upon their ability to learn and deal with the opportunities and challenges associated with sharing of knowledge and best practices within and across organizations (Orlikowski 2002; Edmondson & Moingeon 2003; Leonard-Barton 1995). To this end, there is a growing interest across disciplines in applying and using the notions of organizational learning to understand the dynamics of learning and change within and across organizations. However, the literature on organizational learning is fragmented in terms of disciplinary perspectives, on the units of analysis, learning mechanisms as well as outcomes of learning. One prominent debate in organizational learning literature is the debate between the acquisition (cognitive) and practice-based perspectives of learning.

The acquisition (cognitive) perspective of organizational learning views learning as an acquisition of knowledge from external sources and integration of that knowledge in the organization's current knowledge base (Cyert and March 1963; Argyris and Schon 1978; March and Olsen 1975; Levitt and March 1988; Simon 1991; Huber 1991; Dodgson 1993). In this perspective, the focus is on identifying, noticing, and acquiring existing knowledge that exists tacitly or explicitly (Gnyawali 1999). This form of learning, therefore, focuses on exploiting the already existing information and knowledge through training, instruction and formal education (Gherardi et al. 1998). However, such approaches to knowing and learning significantly ignore the significant attention to the social aspects of learning by conceptualizing knowledge as an object instead of process- i.e. as a mental substance mainly located in individual minds and manifested in written texts, representations and routinized behaviours (Gardner et al. 2003). Due to its focus on individual acquisition of skills and knowledge as the point of departure for organizational learning, the acquisition perspective of learning has been criticized by different scholars. For example, Marshall (2008) argued that "...to the extent that cognitive approaches have relied on models of information processing, it is true that they tend towards a rather static, functionalist and ultimately individualistic portrayal of learning as the passive acquisition of knowledge" (ibid pp: 414).

The practice-based (participation) perspective of learning on the other hand views learning as something distinct from the mere acquisition and assimilation of information and knowledge. Learning is, therefore, treated as a phenomenon situated in social practices occurring through interactions between individuals, between individuals and groups, and between groups. In the context of organizational learning literature, such type of learning is known under several names including 'situated learning' (Lave & Wenger 1991; Brown and Duguid 1991; Richter 1998), 'Social learning' (Sørensen 1998; Elkjaer 1999), 'learning as actual processes' (Cook & Yanow 1993; Henriksoon 1999; Yanow 2000) and as 'practice-based learning' (Gherardi 2000). Practice-based approaches make contribution in countering some of the drawbacks observed in cognitive approaches by treating learning as a dynamic and interactive social process (ibid). It also

“gave an answer to the individual learning bias as well as the bias towards planned and goal-oriented learning” (Huysman & Elkjaer 2006, pp. 3). One weakness of the practice-based perspective is that it treats learning as harmonious, free from tensions, conflicts and power issues (Elkjear & Huysman 2008).

In recent years, there is a growing tendency of establishing meaningful dialogue between cognitive and practice-based approaches. For example, Gnyawali (1999) noted that by adopting either of these perspectives in isolation, one can only see part of the picture of what organizational learning entails. Scholars (such as Gnyawali 1999; Sfard 1998; Elkjaer 2004; Huysman & Elkjaer 2006; Antonacopoulou and Chiva 2007; Skerlavaj & Dimovski 2007; Marshall 2008) also noted on the importance of extending the practice-based approach to include the concept of knowledge that includes acting and thinking, as well as emotion and intuition. In line with this, Elkjaer (2004) and Elkjaer & Huysman (2008) introduced a pragmatic understanding of organizations as social worlds (Strauss 1991) to reconceptualise former understandings of organizations as systems (the acquisition perspective) or organizations as communities of practice (the participation perspective). In social worlds understanding of organizations “...individuals and organizations are understood as being mutually constituted and constituting the ‘systemic’ order of organizational actions and interactions kept together by individuals’ and groups’ commitment to organizational life and work” (Elkjaer, 2004 pp. 421). The social worlds approach, as such, introduced an understanding of organization as neither systems nor participation in communities of practice, but as social worlds held together by commitment to different practices, activities and values (Elkjaer 2005). Similarly, the units of analysis or the unit of learning is no longer the individual or the communities of practice, but is to be found in the network of relations to organizational activities (Hagar 2005; Elkjaer 2005). As it emphasises on the importance of tensions and conflicts as triggers for learning, it provides a strong analytical lens to understand the learning dynamics between different actors belonging to different social worlds and sub-worlds. In the context of this thesis, this perspective is adopted as a theoretical lens to understand the complex dynamics of knowing and learning in customizing and implementing HIS in

public health settings of a developing country. A more detailed description of the social worlds perspective and associated concepts is provided in the third chapter (section 3.3).

1.4 Overview of Empirical Basis and Research Approach

In order to address the specified research questions, this thesis draws empirical data from the ongoing process of developing, customizing and implementing computerised HIS in the context of the Ethiopian public health care system within the framework of the global Health Information System Program (HISP).

Ethiopia is a low income country located in the north eastern part of Africa with a total area of 1.1 million km² and an estimated total population of 79.1 million growing at a rate of 2.7 % with more than its population living in rural areas (CSA 2008). Politically, the country uses a federal structure, comprising of nine regional states and two city administrations³. These regional states and city administrations are further divided into sixty five zones, five hundred twenty three districts (woredas) and more than 10, 000 'Kebeles' (the lowest administrative bounty) (HSDP III⁴, 2005/06- 2009/10)

HISP is a global action research and development network which was initiated in 1994 by researchers from Norway and the Universities of Western Cape and Cape Town in South Africa (Bra & Hedberg 2002; Braa et al. 2004; Braa et al. 2007a). In Ethiopia, HISP was initiated in early 2003 as a collaborative action research project between the Universities of Oslo, Department of Informatics and the Addis Ababa University, Department of Information Science to support the development and implementation of district-based computerised HIS in the context of the Ethiopian public health care system. To undertake its activities, HISP-Ethiopia also signed a memorandum of understanding (MoU) in 2003

³ Tigray, Afar, Amhara, Oromia, Somalia, Benishangul-Gumuz, SNNPR, Gambella and Harari. Plus Addis Ababa and Dire Dawa as city administrations

⁴ HSDP- Health sector development program III- is a comprehensive national plan and serves as a guiding framework for further regional and woreda (district) detailed planning and implementation of the health sector development activities for the coming five years in Ethiopia.

and 2004 to design, develop, customize and implement computer-based HIS in five pilot regions (Addis Ababa, Oromia, Amhara, Tigray, and Benishangul-Gumuz).

In this thesis, I have adopted a qualitative research approach, based on an interpretive research tradition (Walsham 1993), which seeks to understand that complex social, technological and organizational issues are socially constructed and knowledge of it is accessed by studying processes around language and the development of shared meaning (Walsham 1993). As it is pointed out by Walsham (1995a), the interpretive approach emphasises the role of action and the agent, and the dynamics by which they mutually constitute and are constructed. Similarly, in this research, I have observed the existence of complex social, technological and organizational issues related to the development, customization and implementation of HIS that involve situated action and interaction among diverse actors. The focus of this research is to understand how learning unfolds among different actors in the process of introducing computerized HIS in different regional states (mainly Addis Ababa, Amhara, and Benishangul-Gumuz). Therefore, I believe that, the interpretive approach is an appropriate strategy to develop a situated understanding of the context which cannot be understood through quantitative approaches.

As a member of the HISP-Ethiopia team, I have been involved in a variety of activities and interventions related to the customization and implementation of computer-based HIS including: situational analysis of the existing HIS and ICT infrastructure in various pilot regions and at national level; customization of different versions of DHIS (District-based health information software); standardization of existing data elements and reporting formats along with domain experts and other HISP-Ethiopia team members in different regional states; software implementation; capacity building and training of managers, health workers, statisticians at different levels on basics of computers and DHIS software; and solicitation and negotiation with top management at the federal ministry of health and regional levels. This thesis, therefore, is the result of my multi-faceted activities and involvement in the life cycle of the project as part of my PhD trajectory. Apart from the knowledge that comes from different sources during my long

term participation and exposure to the project; empirical material was also collected by using various qualitative data collection methods including semi-structured interviews, observations during meetings and workshops, informal discussions and analysis of documents and e-mails communicated through group mails.

1.5 Expected Contributions

This thesis aims to contribute both theoretically and practically with regard to the development and implementation of information systems (IS) in the context of developing countries. Theoretically, this thesis contributes to deeper understanding of the role of the learning perspective in IS design and development. Primarily, by conceptualizing HIS development and implementation as a process of mutual and interactive learning across distinct social worlds, this thesis introduces a novel lens to study and analyse the development and implementation of IS in general and HIS in particular in the context of developing countries. Secondly, the thesis also developed a conceptual framework that helps to understand the links between learning and the challenges of installed base cultivation, scaling, and sustainability in the context of IS research in developing countries. Practically, the study also contributes in enhancing inter-disciplinary collaboration and learning between health care practitioners and managers, as well as system developers and implementers; contribute in sensitizing managers and IS implementers on the importance of learning approaches to mitigate the challenges scaling and new initiatives and sustaining them in practice at a local level; and contribute on how to manage challenges and tensions through flexible strategies in the process of IS development and implementation in different contexts and settings of developing countries.

1.5.1 Theoretical

Theoretically, this thesis aims to contribute to:

- Build a deeper understanding of the learning perspective in IS development and implementation in the context of developing countries by conceptualizing HIS development and implementation as a process of learning across social worlds.

- Develop a better understanding on how local and situated learning helps to deal with the challenges of cultivating existing systems and practices, scaling local interventions to new sights, and ensuring the long-term viability and sustainability of such systems over time.
- Draw implications for IS research

1.5.2 Practical

The practical contribution of this thesis involves:

- Enhancing inter-disciplinary collaboration and learning
- Valuing the importance of learning in addressing the practical challenges of scaling and sustainability
- Managing challenges through context-sensitive strategies

1.6 Structure of the Thesis

In this chapter I present the general background of the study: the research motivation, the research problem and research questions, theoretical basis, research setting, approaches and methods, and expected contributions. The remaining part of the thesis is organised as follows. Chapter two presents the research setting, approaches and methods. The research setting section provides an overview about Ethiopia where this research was conducted. The research approach and methods section (section 2.2) provides the philosophical assumptions, research approach and methods adopted in this research. Chapter three presents the theoretical framework by emphasising on the debates on organizational learning (section 3.1), different perspectives of learning (section 3.2), and the proposed theoretical framework for this study. Chapter four provides an overview of the research findings primarily by providing a summary of the paper included in the thesis and then providing a synthesis of the findings that integrates the different papers based on core themes linked to the research questions of this study. Chapter five presents the research contributions and concluding remarks based on the empirical findings and theoretical insights.

CHAPTER TWO

Research Setting, Approach and Methods

In the first chapter, I introduced the research motivation, research background, the research questions and the expected theoretical and practical contributions of this thesis. This chapter presents the research setting and research approach employed in this thesis. The research setting section provides an overview of the context where the research was conducted. The research approach and methods section, presents the philosophical assumptions and research approach adopted for this research. This section also provides a detailed description of the methods of data collection and analysis employed in this study.

2.1 Research Setting and Context

This sub-section provides an overview of the research setting and the context where the research was conducted. As such, this section aims to provide a background on historical, geographic, socio-economic, demographic and political context of Ethiopia, an overview of Ethiopian public health care system as well as a background on ICT initiatives in the health sector, and HIS structure and reform initiatives.

2.1.1 Historical and Political context

This research was conducted in Ethiopia, a country located in the horn of Africa between 3 and 15 degrees north latitude and 33 and 48 degrees east longitude (HSDP III (2005/06-2009/10)). Ethiopia is one of the oldest countries in the world with diverse customs, cultures, language and peoples (MoI 2004). As such Ethiopia is characterised as a mosaic of a variety of nations, nationalities and peoples, as well as linguistic groups. Its peoples

altogether speak over 80 different languages constituting 12 Semitic, 22 Cushitic, 18 Omotic and 18 Nilo-Saharan languages (MoI⁵ 2004).

The 19th century marked the beginning of modern Ethiopia where Menilik II (1889-1913) defeated the Italian colonial invasion in 1896 and maintained the independence of the country as well as laid the economic and infrastructural foundation of the modern Ethiopian state (Demeke and Biru 2002; LC-FRD⁶ 2005). His vision of creating a modern state was manifested by establishing diplomatic ties with several European powers, opening the country to western influence and technologies and by authorizing construction of railway from Addis Ababa to Djibouti on the Red Sea (LC-FRD 2005). After the death of Menilik II in 1913, till today three different governments have assumed political power in Ethiopia.

Emperor Haile Selassie I assumed power in 1930 after the death of Empress Zewditu (the daughter of Menilik II). Haile Selassie I, continued the modernization process, but his reign was interrupted in 1935 when Italian forces invaded and occupied Ethiopia. After the end of the invasion in 1941, the emperor pursued a policy of centralization but also exerted numerous efforts to modernize the nation. For example, in 1950 he founded the first higher education institution named University College of Addis Ababa and also introduced reform in areas such as the army and government administration (LC-FRD 2005). However, due to the slow pace of the reform process to effect significant economic and political change combined with rising inflation, corruption, a famine that affected several provinces, and the growing discontent of urban interest groups (including students) led to the overthrow of the Emperor by the military junta in 1974 (Demeke & Biru 2002; LC-FRD 2005).

The military junta known as the 'Derg' which was a socialist by name, but a military in style took power by force and administered the country until may 1997 (Demeke & Biru 2002). The military government nationalized all rural and urban lands as well as major

⁵MoI- Ministry of Information- Federal Democratic Republic of Ethiopia

⁶ LC-FRD: Library of Congress- Federal research Division a country profile- Ethiopia April 2005.
Available at URL: <http://lcweb2.loc.gov/frd/cs/profiles/Ethiopia.pdf> (last accessed April 2009)

business establishments all over the country through a series of proclamations issued between 1975 and 1976 (LC-FRD 2005). The brutality of the regime over its 17 years period, continuous drought and famine in many parts of the country, public dissatisfaction on the regime, and armed resistance and insurrection occurred throughout Ethiopia by different rebel groups (mainly by the EPRDF coalition) hastened the collapse of the military regime in May 1991 (Demeke & Biru 2002).

The Ethiopian People's Revolutionary Democratic Front (EPRDF) coalition and other political parties formed the Transitional Government of Ethiopia (TGE) in 1991 and the Federal Democratic Republic of Ethiopia in 1995 (Demeke & Biru 2002). The new government vowed for a multi-party democracy and economic reconstruction. The constitution of the Federal Democratic Republic of Ethiopia (FDRE) was adopted in 1994 (LC-FRD 2005). The EPRDF led government introduced a federal system of government that divides the country into nine ethnically-based regional states and two city administrations. The national regional states and city administrations are further divided into 624 'woredas' (districts), and again into 15,000 Kebeles (the lowest administrative county) organized under peasant associations in rural areas and urban dwellers associations in towns (HSDP III (2005/06-2009/10)).

2.1.2 Geographic and Demographic Context

Geographically, Ethiopia is characterised as a country located in the horn of Africa with a total area of 1, 127, 127 square kilometres that shares borders with Sudan on the West, Eritrea on the North, Djibouti and Somalia on the East, and Kenya on the South (see Figure 2.1). A country with diverse geographic features, the topographic feature of the country varies from the highest peak at Ras Dashen (with 4,620 meters above sea level) located in the northern highlands to the Danakil depression (at 115 meters below sea level) which is one of the hottest places on earth (MoI 2004). The country has great variation in terms of climate, rainfall, temperature patterns, natural vegetation, soil composition, and settlement patterns mainly due to its diverse topographic feature (LC-FRD 2005). In general, "the highlands above 1,500 meters enjoy a pleasant, temperate climate, with day time temperature between 16⁰c and 30⁰c and cool nights. In areas

below 1,500 meters, daytime temperatures range from very warm (30⁰c) to torrid (upwards of 50⁰c), sometimes accompanied by high humidity” (LC-FRD 2005, pp.5).

Although there are a chain of smaller rift valley lakes in the south, lake Tana located in the north western part of the country is the largest inland body of water in the country (LC-FRD 2005) .

Demographically, Ethiopia has the second largest population in Africa next to Nigeria that is growing at a rate of 2.7 per annum (HSDP III (2005/06-2009/10)). The total population was estimated in 2007 at 81.2 million (MoFED 2007). In terms of age, 43.5% of the population consists of those under the age of 15, 51.9% between the ages of 15 and 59, and only 4.6% of the population comprises those above the age of 60 (HSDP III, 2005/06). Children (between 0 to 14) and youth (between 15 to 24) years together account more than 64 % of the total population of the country, a structure that shows the dominance of the young population as it is the case in many developing countries (HSDP III (2005/06-2009/10); UNESCO 1999). Life expectancy at birth is 54 (53.4 for males and 55.4 for females), where as infant mortality rate is 97/1000 live births (HSDP III (2005/06-2009/10)). The population is mainly concentrated in the northern and southern highlands, the lowlands in the southeast, south, and west for the most part being far more sparsely inhabited (LC-FRD 2005).

Figure 2. 1: Map of Ethiopia and its location in the horn of Africa



2.1.3 Socio-Economic Context

Ethiopia is one of the poorest countries in the world, with a gross domestic product (GDP) of roughly US\$ 6 billion (LC-FRD 2005) and a per capita annual income of about US\$100 (HSDP III (2005/06-2009/10)). Poverty is pervasive with 47% of the population estimated to live below the poverty line with an income of less than a dollar per day (HSDP III (2005/06-2009/10)). Agriculture is the basis of the economy, where more than 85 percent of the population largely depends on it for its livelihood (HSDP III (2005/06-2009/10)). The sector accounts for about 45 percent of the GDP, generates over 90 percent of the foreign exchange earnings of the country, and supplies the bulk of the raw material inputs to the industrial sector (Demeke & Biru 2002). However, the agricultural sector

has not been reformed and modernized for so long in spite of the promises made by different regimes over the years.

Services, including retail trade, public administration, and transportation constitute the second largest component of the economy with 44 percent of GDP. Manufacturing and mining are a distant third and fourth (LC-FRD 2005; Demeke & Biru 2002).

According to a report made by World Bank in 2007, in terms of macro-economic performance, the Ethiopian economy recorded an average growth of 4.5%, in real terms, during the period of FY 2000 to 2004. Between FY 2004 to 2007 the economy registered an average growth of 10% in real terms ranging 11.8 in FY 2007 to about 8.9 in FY 2005 (World Bank 2007). In spite of significant improvements in economic performance over recent years, the country remains amongst the poorest countries in the world. According to UNDP's Human Development Index (HDI) 2007/08 report, Ethiopia ranked 169 out of 179 countries and is at the bottom in terms of nearly of all economic and social indicators including life expectancy and adult literacy (UNDP-HDI 2007/08).

By taking into account the pervasive nature of poverty and backwardness, the current Ethiopian government adopted a long term development strategy since the early 1990's along with sector-specific policies and strategies, and a medium term program aimed at sustainable development and poverty eradication (MoFED 2005). The development strategy is mainly guided by a strategy known as ADLI (Agricultural–Development-Led Industrialization), where the agricultural sector playing a leading role in developing the economy. However, in spite of the new reform initiatives and the financial support provided by rich countries and international financial organizations (such as IMF and World Bank, the economic performance still suffers from hindrances such as public ownership of farmland, low levels of investment, lack of good governance at all levels, corruption in high levels of the government, and dependence on foreign aid and finance (LC- FRD 2005).

2.1.4 Education and Literacy

In Ethiopia, access to education is free from primary to tertiary level and primary education is compulsory mainly for pupils between the ages of 7 and 13 (LC-FRD 2005). Ethiopia has, however, one of the highest illiteracy rates in the world with an average adult literacy rate of 36% (46% for males and 25% for females) (HSDP III (2005/06-2009/10; UNDP-HDI 2007/08). There is also variation on adult literacy rates across regional states. Ethiopia faces many historical, cultural, social and political obstacles that have restricted progress in education for many centuries (UNESCO 1999; ESDP ⁷2007). This includes the dominant view in Ethiopia that work is more important than education, so people start work at a very early age with little or no education (UNESCO 1999). Although it is improving in recent days, the lack of social awareness on the importance of education for individual, societal and national development also negatively affected the progress in the education sector (ibid). In addition to these socio-cultural impediments, most rural families cannot afford to send their children to school because parents believe that while their children are in school they cannot contribute to the household chores and income (UNESCO 1999). Due to this, children in rural areas are less likely to go to school than children in urban areas (ibid). Tertiary education is also at its lower stage though the first university was established 60 years ago. Following the fall of the military regime in 1991, several universities and colleges have been opened across different regional states. However, these institutions are struggling with poor access to the necessary infrastructure and inadequate qualified staff in different specialized areas.

Recognizing the multifaceted shortcomings of the education sector, the current government had issued the education and training policy (in March 1994) and the education sector development program (ESDP) (in October 1996) which identified the problems existed in the sector for so long and put forward strategies to tackle them (ESDP 2007). The education and training policy implemented in 1994 restructured the education system with the goal of improving the quality of education, although results have been mixed (LC-FRD 2005). The primary goal of the ESDP, for example, was to

⁷ ESDP- Education Sector Development Program- Federal Democratic Republic of Ethiopia

achieve universal primary education throughout the country by the year 2015 which is making an impact on the sector (ibid).

2.1.5 ICT Initiatives

The ICT (Information and Communication Technologies) sector in Ethiopia is still characterized by a low penetration of services, including fixed-line telephones and mobile and internet services. One reason cited for this low ICT penetration is the monopoly of the telecommunications sector by the government. Although there have been developments in liberalizing and privatizing the different sectors of the Ethiopian economy, the telecommunications industry remains under the monopoly of the government. The Ethiopian Telecommunications Corporation (ETC) is the only provider of telecommunications services, including fixed and mobile telephone, facsimile, ISP, telegraph and telex services.

Although there is steady increase in terms of fixed-line telephone subscribers over the years (more than doubled from 105, 985 in 1987-1988 to 283,683 in 2000-2001, reaching 725,046 by June 2006) (Chekol 2007); the effective tele-density only reached 1.39% (including mobile phones), which is still a very low figure compared to the Sub-Saharan Africa average of 2.68% (ibid). The mobile sector is growing fast. In June 2006, the number of subscribers reached 866,700, more than double the total of 410,630 in 2005. ETC provides value-added services such as international roaming, SMS, voicemail, general packet radio service (GPRS) and satellite mobile service. The internet market, on the other hand, is poorly developed compared to the potential demand and size of the population. This is mainly due to the ETC's monopoly as the sole internet service provider (ISP). Low-speed, together with high service charges, has also undermined the benefit of Internet connections in Ethiopia. The waiting time for connection and uploading/downloading documents is very long, especially during peak hours. Apart from discouraging individual users, the existing Internet service has become very expensive and many institutions, including several departments of Addis Ababa University, have restricted Internet access time for their staff to limited number of hours (Demeke and Biru 2002).

However, in recent years, the government of Ethiopia firmly indicated its commitment to make a comprehensive use of ICTs to accelerate the democratization and development of the country while, at the same time, reducing the national level of poverty. The Government of Ethiopia, in its current ICT development initiatives, formulated the national ICTs Policy, which is believed to be the driving force of the national socio-economic development and competitiveness. The Ethiopian Government recognizes that in the newly emerging economic order, the basis for socio-economic development and lasting poverty reduction is the use of information and communications technologies in all areas of economic sectors. The Government also recognizes that Ethiopia has no other way to devise other than adopting the order of the day, integrating and implementing the technology to move into ICT-based knowledge economy (ICTDA 2007).

To this end, the government is currently conducting multi-sectoral ICT initiatives and projects. For example, the government's broadband roll-out project introduced a dedicated digital data network (DDN) service that provides a broadband infrastructure with a frame relay connection up to 2Mbps (although the maximum speed that is available currently for subscription is 512 Kbps). Through this service both internet and satellite broadband services are offered. The broadband roll-out aims to deliver IP4-based service through the use of broadband terrestrial and VSAT infrastructure to connect all districts through(Woreda net) and all secondary schools (School net) all over the country. The broadband roll-out also aims to provide access to rural communities, agricultural research institutions, corporate organizations and financial institutions. A total of 600 districts (woredas), around 5,000 rural communities (Kebeles) and 34 agricultural research institutions have already been connected (ICTDA 2007). The ICT policies in the health sector, among others, also emphasizes the need for the improvement and modernization of the health service administration through ICT systems and setup and expand telemedicine to the central and all regional hospitals for better and more rigorous diagnosis (Mussa 2003).

2.1.6 The Health Sector Context

Health care is one of the crucial components of basic social services that have a direct linkage to the growth and development of a country as well as to the welfare of a society. Effective planning and implementation of health services in a given country requires collective efforts of relevant national and international organizations (HSDP III, 2005/06-2009/10). Ethiopia has poor health status even compared to other low income countries in Sub-Saharan Africa.

In Ethiopia, access to health services by the majority of the population is very limited, though there are improvements in recent days. As Mussa (2003) noted, “the health care system is able to provide basic health services to only about 60% of the population” (Mussa 2003, pp.9). As per the report of HSDP III (2005/06-2009/10), “poor nutritional status, infectious diseases and a high fertility rate, together with low levels of access to reproductive health and emergency obstetric services, contribute to one of the highest maternal mortality rates in the world (871/100,000 live births), high infant mortality rate (97 deaths/1,000 live births), and high under-five mortality (140 deaths/1,000)” (HSDP III (2005/06-2009/10, pp.5). HIV has also become a major threat to health with large number of new victims increasing annually in most regions of the country. Ethiopia ranks second to South Africa among Sub-Saharan African countries in terms of HIV infected adult population. Malaria is also a major cause of mortality particularly at altitudes of below 2000 meters. These significant health problem need to be addressed primarily through a publicly organized health care system (HSDP III (2005/06-2009/10).

The existing status of poor health services is the reflection of the overall socio-economic indicators which is mainly characterized by widespread poverty, low income levels of the population, low level of literacy, inadequate access to clean water and sanitation facilities and poor access to health services (Mussa 2003; HSDP III (2005/06-2009/10). Generally, the health delivery system used to be highly centralized, delivered in a fragmented way and related to vertical health programs and services with little collaboration with the private sector (Mussa 2003).

Since 1993, Ethiopia has been pursuing a wholesale transformation of the public health care system with clear commitment to ensure equity in resource allocation, restructure and decentralize the health care systems according to a 'district health system' and deliver health care according to the principles of the primary health care approach (Vital wave consulting 2009). In order to deal to the prevailing and newly emerging health problems in the country, the Ethiopian government has developed a 20 year rolling Health Sector Development Program (HSDP) that proposes long-term goals for the sector, and the means to attain them by way of a series of phases (HSDP III (2005/06-2009/10). The policy aims to give strong emphasis to the fulfillment of the needs of less privileged rural population. HSDP is structured with a series of five-year rolling investment programs, of which the first Health Sector Development Program (HSDP I) covered the period 1997-2001, the second HSDP II covered 2002-2004, and the third HSDP III covering the period 2005/06- 2009/10. In 2004, the Ethiopian Government adopted an Essential Health Services package (EHSP) with the aim of making health services available to all segments of the population living both in urban and remote and backward regions and districts. The EHSP aims "to provide equal access to essential health services and covers five major health interventions" (Vital Wave Consulting 2009).

Important steps have also been taken in the decentralization of the health care system. Decision making processes in the development and implementation of the health system are shared between Ministry of Health (MoH), the Regional Health Bureaus (RHBs), Zonal health departments (in some regional states) and the woreda (district) Health Offices. In the new policy, overall responsibility for health policy and regulation is assigned to the Federal Ministry of Health (FMoH) in Addis Ababa, while responsibility for management of health service delivery falls to the respective Regional Health Bureaus (RHBs). As a result, management of health facilities, personnel, and health training institutions within each respective region is carried out by the RHBs. In some regional states, the RHBs get support in this function from Zonal Health Departments while the woreda health offices have been made to play vital roles of managing and coordinating the operation of the primary health care services at woreda (district) levels (WHO_HMN

2007). The current health delivery system is also organized into a four-tier system consisting of primary health care units (PHCU), district hospitals (DH), Zonal Hospitals (ZH) and Specialized Hospitals (SH) (MoH⁸ 2007). As such, the PHCU includes a health center with five satellite Health Posts (HP) and is aimed to serve 25,000 population located within 10 KM radius catchment area. The DH on the other hand is intended to serve 250, 000 population and as a referral and training center for 10 PHCUs. The ZH offers specialized services and training to a population of 1 million; where as a SH provides specialized services and serve as a post-basic training and research center (ibid).

2.1.7 Health Information System (HIS) in Ethiopia

The Health Sector Development Program (HSDP) has clearly indicted the importance of strengthening Health Management Information Systems (HMIS) as one of the major components of the HSDP since 1997 (HSDP 2005/06 – 2009/10). As it is indicated in this strategic document, the primary aim of HMIS is “... to support informed strategic decision-making by providing quality data that help managers and health workers plan and manage the health service system” (ibid pp. 4).

The Health Management Information system (HMIS) at a national level is organized vertically under four departments: Disease Prevention and Control; Family Health, Hygiene and Environmental health and planning and programming. Each department consists of a team of people responsible for a specific health program. Each program in turn has a separate set of data collection instruments which are managed by the respective health program officer. The Health Information Processing and Documentation Team (HIPDT) which is under the planning and programming department is primarily responsible for the collection of morbidity and mortality data. Other reports are collected by the departments respective to each health program. At the national level, reports are received from all RHB, Federal hospitals, Police Hospitals and defense hospitals annually, biannually, and quarterly.

⁸MoH- Ministry of Health- Federal democratic Republic of Ethiopia

The existing HIS in Ethiopia is poorly organized and un-standardized. Besides, HIS functions in a top-down fashion, implying that while planning and implementation of health systems is done at the level of the central ministry of health (MoH), where as health data is collected using paper form at health facility level and sent up to the district, zone, region and ministry. The devolution of power from the Federal Ministry of Health (FMoH) to the regional health bureaus (RHBs) had resulted to multiple HIS across different regions. AS it is reported in HSDP III (2005/06-2009/10), more than 150 HIS reporting formats that do not conform to the reporting formats of other regions were identified in one of the regional states. Besides, the resistance by various disease specific health programs to have their own separate sets of data collection instruments, data sets and indicators also contributed to the current fragmented and un-standardized HIS in Ethiopia. This has resulted in multiple reporting formats, fragmentation of reports, and an increased administrative work load for lower level managers and health workers. As Braa and Blobel (2003) described, such excessive and un-coordinated data collection is a huge burden on health facilities. Such systems tend to be centralized with little local use of information for action, and the fragmentation between different health programs and services leads to overlaps, gaps and lack of standard definitions for data elements and indicators (Kimaro, Mengiste & Aanestad 2008).

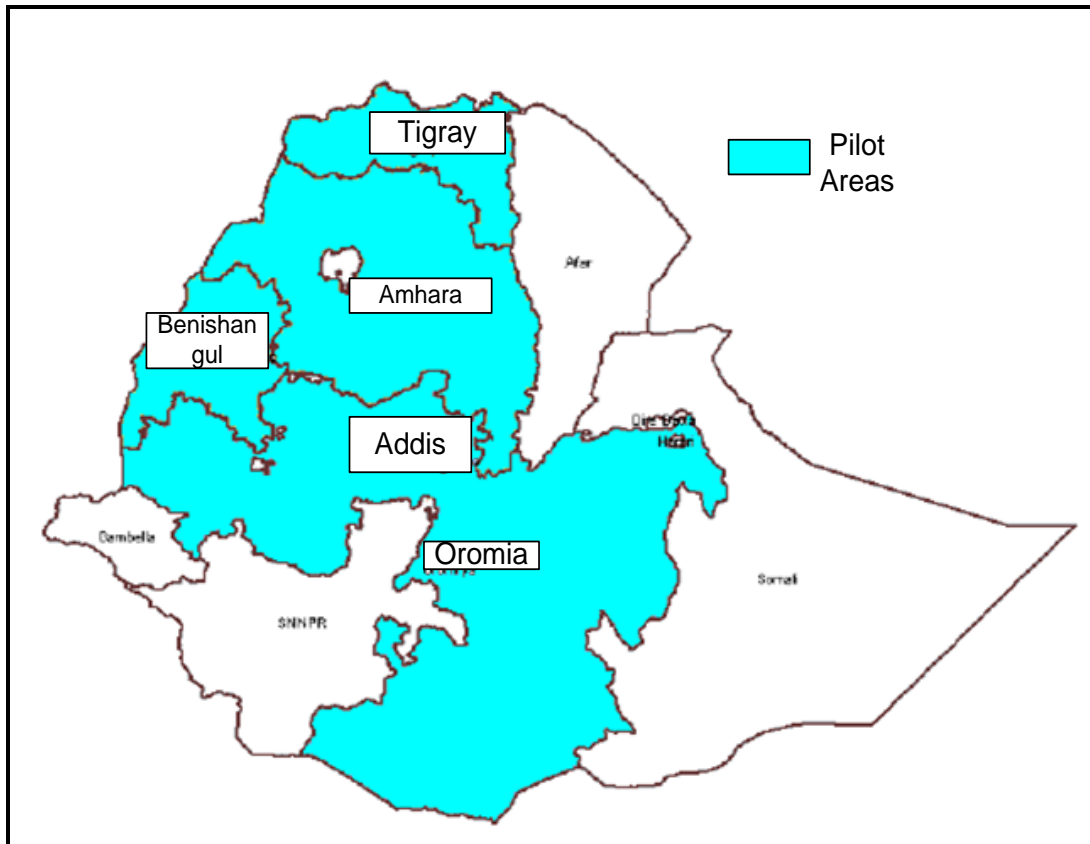
2.1.7.1 HISP Initiatives in Ethiopia

This research is set within the umbrella of HISP research project, which was started in 1994 by researchers from Norway and the Universities of Western Cape and Cape Town. HISP has developed different versions of free and open source database application called DHIS (District Health Information Software). The principal goal of HISP research is to design, implement, and sustain HIS for supporting primary health care delivery at the grass root levels for developing countries. HISP seeks to create networks for sharing ideas, experiences, knowledge, technology and value among the various nodes of its network. Within different countries, HISP embraces particular local institutions, people, researchers, research outputs, software, data elements, health indicators, training material, ideas, and learning experiences (Braa et al. 2004). HISP is at various stages in many

countries in the south including South Africa, India, Tanzania, Ethiopia, Malawi, Botswana, Sierra Leone, Vietnam and Nigeria (see Braa et al. 2004; Braa et al. 2007a).

HISP-Ethiopia has been initiated through a collaboration of the Department of Information Science, Addis Ababa University and the University of Oslo in 2003. Furthermore, a memorandum of understanding (MoU) has also been signed between HISP, represented by the Department of Information Sciences, and five Regional Health Bureaus of Ethiopia (i.e., Oromia, Amhara, Tigray, Benishangul-Gumuz, and Addis Ababa) to carry out HIS development and implementation activities (see figure 2.2 for HISP pilot sites).

Figure 2. 2: *HISP pilot sites in Ethiopia*



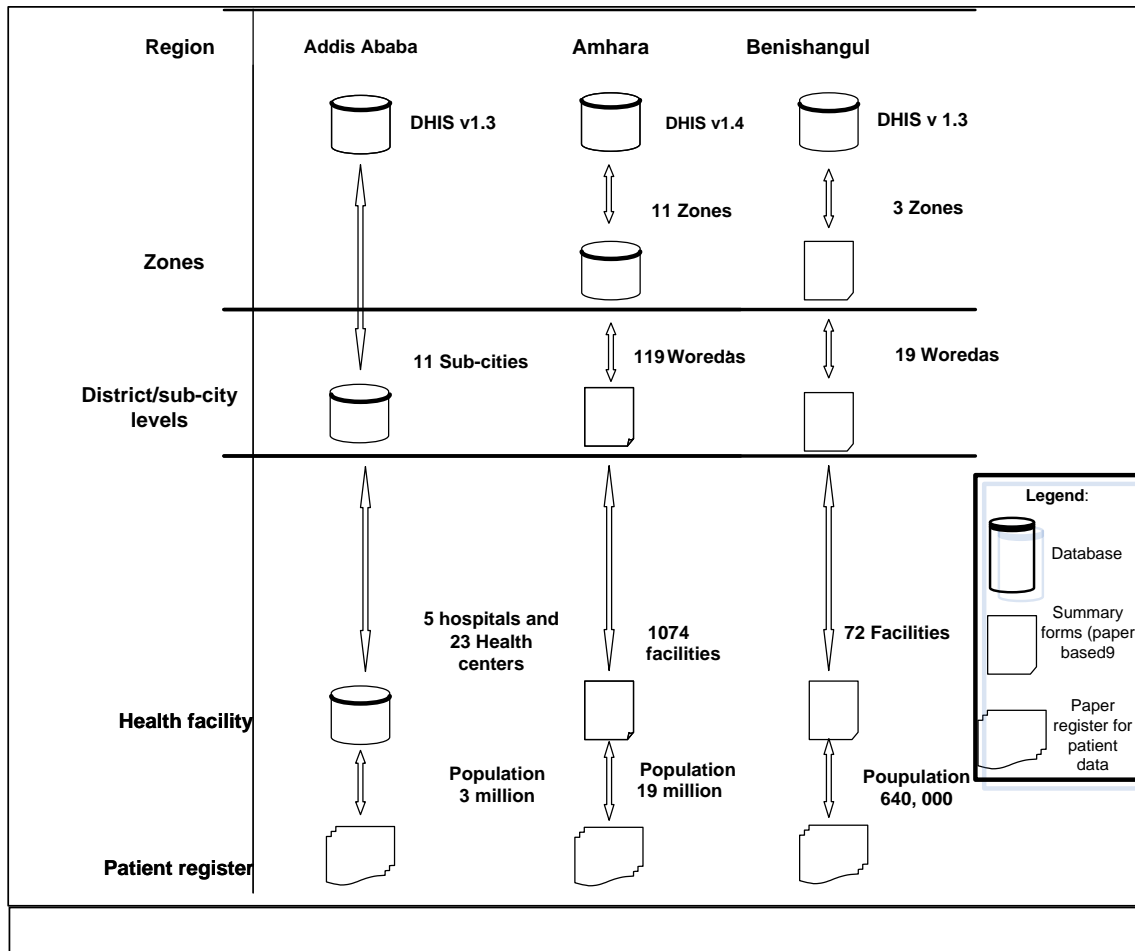
Over the period 2003 to 2005, a group of MSC and PhD students (including myself), all from Ethiopia formed the HISP-Ethiopia team and have been involved in the assessment

and making improvements in the HMIS in 5 regions of Ethiopia as part of their university studies in collaboration with the respective regional health bureaus. This study has involved making a situation analysis of current HMIS including analysis of data items, reporting formats, data flows, use of information and indicators. Following this situation analysis and the identification of key problems, The HISP-Ethiopia team has been engaged in making improvements through the design, development and implementation of a customized open source software (called District Health Information Software – DHIS), capacity building and training, and creating awareness about the HMIS challenges and the need to develop a culture that supports information use rather than just seeing data as something to be reported to the higher levels of the bureaucracy.

DHIS software has been customized and implemented in all public health institutions of the Addis Ababa Health Bureau (AAHB) since 2004 to capture routine health information. Four additional pilot regions (namely Amhara, Benishangul-Gumuz, Oromiya and Tigray) have also been at different stages of customizing and implementing the software. As it is reported in the empirical findings of this study, DHIS had contributed significantly in improving the quality, timeliness, and availability of information through techniques such as data entry validation, electronic data transfer, and the creation of central data warehouse with analysis tools (such as pivot table and graphic analyzer). The flexibility of DHIS database application helped to manage the continuously changing data sets at national, regional and district levels. As such, the introduction of the technology makes it possible to add, edit or remove data elements, indicators and manage multiple data sets at different levels.

This research was conducted in three of the five pilot sites (Addis Ababa, Amhara, & Benishangul-Gumuz regional states). Figure 2.3 shows the flow of data and level of implementation of DHIS software in each respective regional state where this research was conducted.

Figure 2. 3: Data flows and the level of DHIS implementation in three regional states



2.2 Research Approach and Methods

This thesis adopts the qualitative research approach mainly due to its wider acceptance within the IS research community as being able to provide insights in investigating information systems phenomena (Myers 1997; Orlikowski and Baroudi 1991; Walsham 1993, 1995a). The empirical work is informed by an interpretive approach which rests on the fundamental assumption that knowledge is socially constructed, and is shaped by and also shapes the social context (Walsham 1993). This section, therefore, presents approaches in IS research (section 2.2.1), the interpretive research approach as a research paradigm adopted in this study (2.2.2), and the research design including methods of data collection and analysis (section 2.2.3).

2.2.1 Approaches in IS research

Based on the underlying philosophical assumptions, Orlikowski & Baroudi (1991) and Myers & Avison (2002) categorized IS research into three categories of research paradigms: Positivist, Interpretive, and Critical. Different research methods such as case study, action research, grounded theory can be positivist, interpretive or critical (Walsham 1995a).

The major difference between positivism and interpretivism concerning research are three fold. *Ontologically*, positivists believe that reality exists objectively and independently from human experiences which interpretivists emphasize the subjective meaning of the reality that is constructed and reconstructed through a human and social interaction process (Chen and Hirschheim 2004). *Epistemologically*, positivists are concerned with the hypothetic-deductive testability of theories. Scientific knowledge should allow verification or falsification and seek generalizable results. As such, a causal relationship is usually presented and a tight coupling among explanation, prediction and control is expected (Orlikowski and Baroudi 1991). Interpretivists, by contrast, assume that scientific knowledge should be obtained not through hypothetic-deductive reasoning but through the understanding of human and social interaction by which the subjective meaning of the reality is constructed (Walsham 1995a). *Methodologically*, positivists

contend that, to test hypothetic-deductive theory, research should take a value-free position and employ objective measurement to collect research evidence. Interpretivists, on the other hand, argue that to understand the meaning embodied in human and social interaction, researchers need to engage in the social setting investigated and learn how the interaction takes place from the participants' perspective (Orlikowski and Baroudi 1991).

This study falls under the framework of the interpretive paradigm where the researcher investigated how tensions and conflicts have been addressed through the actions interactions and negotiations of different actors from multiple social worlds in the process of developing and implementing computerized HIS in context of the Ethiopian public health care system. An overview of the interpretive paradigm is presented in the following section.

2.2.2 The Interpretive Research Approach

The philosophical base of interpretive research is hermeneutics and phenomenology (Boland 1985). As such, interpretive researchers assume that access to reality is only through “social constructions such as language, consciousness, shared meanings, documents, tools and other artifacts” (Klein and Myers 1999 pp.69). The interpretive approach asserts that “reality, as well as our knowledge thereof, are social products and hence incapable of being understood independent of the social actors (including the researchers) that construct and make sense of reality” (Orlikowisy & Baroudi 1991, pp. 13). In an interpretive research project there are “no predefined dependent and independent variables rather the focus is on the complexity of human sense-making as the situation emerges” (Klein & Myers citing Kaplan and Maxwell 1994, pp.69), and how inter-subjective processes are shaped (Boland 1991; Walsham 1993, 1995a). In an interpretive research, it is difficult to obtain a value-free or objective data, since the research process itself relies on the researchers' pre-occupations (Walsham 1995b).

Using the interpretive approach in IS research would help to increase our understanding of complex social, technological and organizational issues related to the implementation and adaptation of ICTs/ISs in different organizational contexts. As Walsham (1993)

pointed out the purpose of the interpretive approach in IS is to “produce an understanding of the context of IS and the process whereby IS influences and influenced by the context” (ibid, pp. 4-5). In the context of IS research, the interpretive approach seeks to understand the dynamics of information technologies and organizations through the meanings which people assign to them in an ongoing mutual adaptation and shaping process. Interpretive approaches give the research greater scope to address issues of influence and impact, and ask questions such as ‘why’ and ‘how’ particular technological trajectories are created (Boland 1991; Orlikowski and Baroudi 1991; Deetz 1996). Orlikowski and Baroudi (1991) outlined the following criteria to be met in interpretive studies: the object had to be examined from the perspective of the participants; analyzed within a specific and detailed cultural and contextual perspective; outcomes had to be regarded as non-deterministic, and that the complex interactions and interpretations of individuals and groups to be seen in heterogeneous resultant systems. Klein and Myers (1999) also developed a set of principles to conduct and evaluate interpretive research in information systems.

In this thesis, the interpretive research paradigm has been adopted. As such, the research is based on the idea that the human mind creates the meaning of social reality, and more specifically the implementation of computerized IS. Ontologically, therefore, I assume that, IS development and implementation is a social reality constructed and reconstructed through the process of ongoing individual as well as group actions, interactions, and negotiation within and between multiple social worlds. Epistemologically, I assume that, knowledge about the development and implementation of IS is mainly generated through our interaction and being part of the social world of those generating it. The interpretive approach, is therefore, adopted to understand the social and organizational issues involved in the process of adapting, implementing, using, and scaling computerized HIS and associated processes and practices in the context of the Ethiopian public health care system. As such, in this research, an attempt was made to understand learning processes and how tensions and conflicts in interest, commitment and values addressed when different actors from different social worlds come together and interact, communicate, and negotiate in the process of adapting and implementing new technologies, standards and

systems in the context of the public health care systems of developing countries. This study has also been informed by the set of principles developed by Klein and Myers (1999). While they present the principle of interaction between the researcher(s) and subjects, the authors noted that “the facts are produced as part and parcel of the social interaction of the researchers with the participants” (Klein & Myers 1999, pp. 74). Our involvement in the domain as supporters of the software projects enabled us a unique access to the processes and rich contextual exposure, but also a prescribed role which limited our coverage. The researcher’s relation to the other stakeholders was one of project partners, not as an independent researcher in an observation role. As such, the interactions, communication and negotiations that are described in this thesis are more focused in the positive learning that did happen, rather than on what did not happen. Moreover, my understanding and conceptualizations of my overall experience in the project have also been iteratively developed according to Klein and Myers’ basic principle of the hermeneutic circle.

2.2.3 Research Design and Methods

Depending up on the philosophical perspective adopted, qualitative researchers could adopt various research methods (Myers & Avison 2002). According to these authors, research method is “a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection” (ibid pp. 7). The most commonly used qualitative research strategies are: Action research, Case study research, Ethnography, and Grounded Theory (Myers & Avison 2002).

In this research, the case study approach has been adopted as a research strategy. Yin (1994) defines case studies as an empirical inquiry that: “investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used” (ibid pp. 13). Myers & Avison (2002) also characterized case study research as a research strategy used both in positivist, interpretivist, or critical research approaches depending upon the underlying philosophical assumptions of the researcher. Yet, case studies with

different philosophical assumptions can have some common characteristics. As Stake (1994) pointed out, case studies are usually characterized by the researcher spending substantial amount of time in close contact with the different events and processes taking place in the case. As such, case study is not only seen as a specific methodological choice, but also as a choice of object to be studied (Stake 1994). Various case studies, including interpretive case studies often rely on multiple data sources. For example, Yin (1994) identified six different sources of evidence that are relevant for data collection in case study research: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts.

However, Walsham (1995a) argued that the primary source of evidence in the context of conducting interpretive case study research is in-depth interviews, “since it is through this method that the researcher can best access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants” (ibid pp. 78). Walsham (1995a) also noted the importance of observation in interpretive case studies mainly to be able to ask relevant questions as well as to get a better understanding of how the thing being studied functions and being used in practice. Observation can take two different forms: the researcher can act as an external observer by simply observing different activities with little interference; or act as a participant observer aiming at becoming a full participant in the activities studied (Walsham 1995a; Blomberg et al. 1993).

In this thesis, the interpretive case study has been adopted as a research strategy mainly because of its strength to understand IS development and implementation in organizational contexts (see Walsham 1993, 1995a; Myers & Avison 2002). As Walsham (1993) indicated, an interpretive case study helps to understand how information technology shapes and is shaped by work practices. Similarly, this study is about the design, development and implementation of computerized health information system (HIS) in health care settings of developing countries. More specifically, it primarily aims to understand tensions and conflicts that trigger mutual and interactive learning between actors from different social worlds in the process of developing and

implementing computerized HIS in the context of low income countries; and secondly to explore how local and situated learning helps to understand as well as address the challenges of installed base cultivation, scaling, and sustainability. As such, I see three main reasons why the interpretive case study research approach is a viable strategy for this study. Firstly, the focus of my study is to explore the challenges of IS development and implementation in a real world setting, learn about the tensions, conflicts and challenges of introducing the system, and improve existing practices and routines based on shared understanding and mutual learning. Secondly, the interpretive case study approach helps to study and observe the real life dynamism and complexity of IS development and implementation in public health care settings of developing countries. Thirdly, the interpretive case study approach is an appropriate way to study IS development and implementation in situations where the boundaries between the organizational context and the phenomenon itself are not clearly evident.

As such, this research was designed and implemented along the principles of interpretive case study where the researcher acted as a participant observer and involved in various activities including situational analysis of the existing HIS in different regions, worked as a member of the HISP-Ethiopia team and involved in various intervention activities including software customization, standardization, user training, and evaluation at regional (provincial), zonal and district (woreda) levels of the Ethiopian public health care system. The research was conducted in three different HISP pilot regions (Addis Ababa, Amhara, and Benishangul-Gumuz) and attempted to understand the multi faceted challenges of implementing computerized HIS. The research was conducted over a period of four years divided into six time periods: June to August 2004; February to May 2005; September to December 2005; May to August 2006; September to December 2006; and September to November 2007.

The findings of this study are, therefore, results of the researchers extended involvement in multi-faceted activities of the HISP project in Ethiopia including situational analysis, software customization, capacity building activities of health workers and managers at different levels, and interaction and negotiation with diverse stakeholders at national,

regional, zonal and district levels in the process of adapting and implementing computer-based health information systems in the Ethiopia within the framework of the HISP initiative. This had helped me to develop a much deeper understanding of the situated nature of learning that is developed through the actions and interactions of different stakeholders from multiple social worlds and sub-worlds. The research had also used different qualitative data collection methods to gather data on different issues and topics addressed in this thesis. The following sub-section provides an overview of those methods used.

2.2.3.1 Methods of Data Collection

The methods used by qualitative researchers exemplify a common belief that they can provide a deeper understanding of social phenomena than would be obtained from purely quantitative data. Qualitative studies generally collect data by using several methods. The most commonly used data collection methods of qualitative research approach are: interviews and questionnaires, observation and participant observation, analysis of documents, and the researcher’s impressions and reactions (Silverman 2001). Silverman (2001) argues that, qualitative researchers seek to map inner experiences, language, cultural meanings, or forms of social interactions to develop deep conceptual understanding of phenomenon. Silverman (2001) identified some features and claims of the different data collection methods (see table 2.1 below).

Table 2. 1: Methods of qualitative Research (Source: Silverman 2001, p.90)

<i>Method</i>	<i>Features</i>	<i>Claim</i>
Observation	Extended period of contact	Understanding of subculture
Texts and documents	Attention to organization and use of such material	Understanding of language and sign systems
Interviews, Surveys, and Questionnaires	Relatively unstructured and ‘open ended’	Understanding ”experience”
Audio and video recording	Precise transcripts of naturally occurring interactions	Understanding how interaction is organized

In this study, data was collected through semi-structured interviews with key informants from the public health care system of three regional states (Addis Ababa, Amhara, & Benishangul-Gumuz), Ministry of Health planning and programming department, HISP-Ethiopia team members and members of the HISP-International development team; observation of work practices, in-depth investigation and analysis of secondary data, and by participating in workshops. Each of these methods is discussed in the subsequent sub-sections.

a) Semi-structured Interview

Interview studies are used to elicit respondents' perceptions. Interviews offer the chance to explore topics in-depth and to gain appreciation of the context of the phenomena. Silverman (2001) argues that when conducting interviews, the researcher is responsible to think how far the respondents attach a single meaning to their responses. The interview was conducted at different stages of my field work from June 2004 to November 2007, and it was conducted with service providers at clinics, health posts, health centers; program officers (experts and team leaders); heads of health facilities/institutions; heads of health programs, head of the regional health bureau, developers and implementers from HISP (both local and global), implementers, and facilitators. A total of 86 informants (32 from Benishangul-Gumuz, 23 from Amhara, 17 from Addis Ababa, 3 from national Ministry of Health and 11 developers and implementers from HISP local and international team) were interviewed (see table 2.2 for details). Questions asked during those interview sessions were open-ended and semi-structured. Most of the interviews were conducted formally by getting an appointment with respondents. Informal interviews with some individuals during coffee-break were also conducted.

During the interview, different questions such as: the time spent on data collection, analysis and reporting, factors affecting timely reporting of monthly data, local data analysis and information use for local decision making, the way they communicate with the higher levels in the hierarchy, problems they encountered in doing their day to day tasks, HIS related challenges encountered were discussed. Individuals working on statistics at regional level and managers at zonal and regional levels were also asked

specific questions regarding the quality and accuracy of the data received from lower levels.

During the interview, extensive notes were taken and in some cases interviews were tape recorded as per the consent of the informants. For some respondents, who have a problem to communicate in English, the interview was conducted in Amharic (the national language in Ethiopia) so that respondents will be more comfortable to express their feelings and ideas properly. The interviews were then translated into English for analysis shortly after the interview session or at least in the same day. Transcription of audio recorded interviews and summarizing of the notes taken during the interviews were also conducted in the same day.

Table 2. 2: Distribution of interviewees across settings and their position

Working level	Respondent Category	No. of Respondents
National Level (FMOH)	Department head	1
	Unit head	2
Addis Ababa	Bureau head	1
	VP Manager	2
	Planning and program	1
	Sub-city managers	5
	Statisticians	8
Amhara	Bureau head	1
	VP manager	3
	Planning and program	4
	Zonal HIS officer	11
	District/Woreda officers	4
Benishangul-Gumuz	Bureau head	1
	VP Manager	3
	Planning and program	2
	Zonal health officers	2
	Health workers	24
HISP team members	Local Developers	4
	HISP researchers	2
	Global Developers	3
	facilitators	2
	Total	86

b) Participant observation

I was involved in many interventions introduced by HISP-Ethiopia since the inception of the project in 2003. I was for example involved in many of the discussions conducted with the top management team of the AAHB, Amhara regional health bureau and Benishangul-Gumuz health bureaus. I was also involved in customizing DHIS software for Amhara and Benishangul-Gumuz regional states, provide user training, and participate in a series of meetings and discussions held to standardize existing data collection and reporting tools. In Benishangul-Gumuz, I observed statisticians and health workers at Assosa zone, two districts (woredas) (Assosa and Menge), and Assosa Hospital while they conduct their routine data compilation and report generation tasks. I was also highly involved in setting up a two days workshop for health workers and health managers at different levels to discuss issues related to the existing health information systems and potentials of introducing computerized district-based health information system in the region within the umbrella of HISP. I was also involved in the customization of DHIS software and in giving trainings for health workers at regional and zonal levels. In Amhara regional state, along with other HISP team members in the region, I travelled across all the 11 zones and observed HIS officers while conducting data analysis and report generation using DHIS software; participated in skills upgrading session in using DHIS software which was offered to zonal HIS officers in their work settings. In Addis, I observed statisticians in four hospitals, HIS officers at 8 sub-cities and the regional planning and programming unit at different stages of standardization, customization, implementation and post-implementation while they undertake their daily routine activities of data entry, compilation, analysis and report generation tasks. During my observation, notes were taken about the things I observed and themes were created about the issues addressed.

A



B

Figure 2. 4: *Pictures from the field work (A- On-site training and software customization (Amhara); B- Attending a workshop with health workers and managers (Benishangul-Gumuz))*

c) Discussions, Meetings and Workshops

Another data source used in this thesis was participating in workshops, meetings and discussions at national, regional levels. In 2003, when HISP was initiated in Addis Ababa Health Bureau, I participated in the first meeting held with the head of regional health bureau, head of the planning and programming department, and vertical program heads to discuss on the possibilities of customizing and implementing DHIS in the region.

In 2004, I was also participated in a two day workshop held in Assosa (the capital of Benishangul-Gumuz region) to discuss the problems of the existing HIS and potentials of implementing a new computer-based district health information system in the region. The participants of the workshop included health workers at different health facilities in Assosa zone, health managers at different levels, heads of different vertical programs, regional health officials. During the workshop, participants raised lots of issues including the problems of infrastructure and financial and human resources to deal with the new initiative; the lack of feedback and proper communication due to the hierarchical and top-

down structure of the existing system; potentials to improve the existing system and many more other issues. This was the first workshop held to address problems related to health data management and HIS issues in the region. In Amhara, I participated on a number of meetings and discussions held with managers at different levels of the public health care system (regional, zonal and district levels). At a national level, I participated in a meeting held with members of the national advisory committee (NAC) on HMIS that discussed several issues including the contribution of HISP in the reform process. I was also part of a national workshop organized by HISP in 2006 to create awareness on its strategies, approaches and the software used to representatives from the Federal Ministry of Health (FMOH), regional health bureaus, and other national and international partners including representatives from European Union (EU). I also observed local development teams and implementers (at HISP office in Addis Ababa University) while conducting their routine tasks of software customization, defining standard reports and struggling to understand new development tools and technologies. During those meetings and workshops notes were taken about the comments and discussions held among participants and they were summarized at the end of the workshop.

d) Document Analysis

Analysis of documents such as: reporting forms, graphs, tally sheets, copies of monthly reports, and registers was also conducted. Registration books were assessed for availability for each health service provided and uniformity among the different health facilities. Official reports written by different bodies that deals about the health system structure and the health information system of the region were also investigated and analyzed. Such documents found to be useful to learn about major events, historical decisions made, key actors in the health system and their roles. Besides it gave me background information to conduct the interviews and to explore in further detail particular responses during the interviews. Besides, analysis of e-mails communicated between HISP-Ethiopia team members, global developers and researchers was also used a source of data.

2.2.3.2 Modes of Analysis

A mode of analysis refers to the various techniques used to analyze the empirical data gathered through various interpretive data collection methods. The mode of analysis in this research was informed by the interpretive approach (Walsham 1993, 1995a). As Myers and Avison (2002) pointed out, in doing qualitative research, there is no clear distinction between the gathering and analysis of data as is commonly made in quantitative research. Agar (1980) also noted that, in doing qualitative research, data collection and analysis is “a dialectic process in which you learn something (‘collect some data’), then you try to make sense out of it (‘analysis’), then you go back and see if the interpretation makes sense in light of new experience (‘collect more data’), then you refine your interpretation” (ibid, pp. 9). Similarly, in this research there was no clear demarcation between my data collection and analysis, and the process was an iterative cycle of data collection, reflecting upon it, developing certain themes and linking them to my main research aims and objectives. It was a continuous process in which the analysis affects the data and the data affects the analysis in significant ways.

Besides, in an interpretive research, theory is often considered to play a significant role in the sense that it provides a ‘sensitizing device’ for analyzing the empirical data collected from field work. Walsham (1995) also noted that, in interpretive research researchers can use a social theory to get insight into a social situation. Similarly, the research presented in this thesis draws on a social theory for the following purposes. Primarily, theory on organizational learning and more specifically, the social worlds perspective provided me a useful way of mapping an important part of the heterogeneous actors and the different social worlds participating in the process of HIS design, development and implementation. My early analysis of findings has been very much focused in identifying challenges and in exploring strategies based on experiences, best practices and lessons learnt while diverse stakeholders work together to introduce change in the existing paper-based system in different contexts. The emphasis in identifying challenges and formulating context-sensitive strategies based on lessons from past experiences and on-

going activities, had significantly inspired me to look for a theoretical approach that addresses issues of learning in IS development and implementation.

Then, at latter stages of my study, the social worlds perspective of learning had been adopted as my analytical lens. Adopting this theoretical framework had contributed in framing my analytical focus in different ways. Primarily, it helped me to identify the different social worlds (sub-worlds) that interact, communicate and negotiate in adapting and implementing HIS. Secondly, theory has been used as a ‘sensitizing device’ to make sense and analyze the research findings. More specifically, while the early analysis of the empirical findings contributed to the writing of different papers for conferences and Journals; the use of theory as a ‘sensitizing device’ to analyze the findings was taken to its higher level at the stage of writing this Kappa. At this stage, an attempt has been made to bring a more holistic and integrated learning framework based on Elkjaer’s (2004) ‘third way’ perspective which has been used to make a sound analysis of the empirical findings in terms of tensions and conflicts that trigger learning among different stakeholders within and between different social worlds. The notion of negotiated order had also been introduced to conceptualize HIS development and implementation as a negotiated order mediated by different boundary objects.

CHAPTER THREE

Conceptual Framework

This chapter presents an overview of the theoretical framework that has been used as an analytical lens to investigate the research questions posed in this thesis. This thesis is mainly informed by perspectives from organizational learning theory with additional influence from Anselm Strauss theory of social worlds and negotiated order. The different perspectives and approaches of organization learning theory and more specifically, the social worlds perspective provided me a useful way to enrich my conceptual understanding of the empirical research and in mapping an important part of the heterogeneous actors and the different social worlds. The chapter is divided into four main sections. Section 3.1 presents a general overview of organizational learning debates and approaches. Section 3.2 gives an overview of the different perspectives of organizational learning: where section 3.2.1 presents debates on acquisition (cognitive based) perspectives; section 3.2.2 presents the participation (practice-based) perspective of organizational learning, and section 3.3 presents the ‘third way’ as a new approach to organizational learning. The last section (3.4) presents the theoretical framework adopted for this thesis.

3.1 Organizational Learning: Debates and Approaches

As our world becomes more complex, inter-connected, and uncertain; it is crucial that the capability of individuals, groups and organizations to learn regularly and rigorously from their day-to-day work activities and practices is encouraged so that they may adapt rapidly and continuously to their changing environment (Garratt, 1999). Organizational learning is an area of research that deals with such issues and challenges. Although organizational learning is not a new concept, the concept is devoid of a unified consensus by academics researching in the field (see Levitt and March 1988; Huber 1991, Dodgson

1993; Miner & Mezias 1996; Argyris & Schon 1996; Crossan & Guatto 1996; Easterby-Smith 1997; Easterby-Smith et al. 1999). One source of this lack of unified consensus is the diverse disciplinary origins and the associated perspectives. For example, it is an area of research and debate in the field of psychology, organizational theory, innovation management, strategic management, economics, organizational behaviour, sociology, political science, information systems, anthropology, and production/industrial management (see for example Argyris & Schon 1978; Shivastava 1983; Fiol & Lyles 1985; Perrow 1986; March 1991; Dodgson 1993; Cook and Brown 1999; Robey et al. 2000). As Antonacopoulou & Chiva (2007) pointed out, the way organizational learning is conceptualized has unfolded over time as a result of the various perspectives that have dominated the debate: the behavioural aspects (Cyert and March, 1963; Levitt and March 1988), the cognitive issues (Duncan and Weiss 1979; March and Olsen 1975), the socio-cultural dimensions (Cook and Yanow 1993; Lave and Wenger 1991) and more recently the practice-based view (Nicolini et al. 2003). The following table presents a summary of the disciplinary perspectives on the debates and approaches of organizational learning as presented by Easterby-Smith.

Box 3.1: Summary of Disciplinary perspectives on organizational learning (Source Easterby-Smith, 1997)

- **Management Science:** concerned with gathering and processing of information in and about the organization
- **Sociology and Organizational Theory:** focuses on the broader social systems and organizational structure where learning becomes embedded and which affect organizational learning
- **Strategic perspective:** focuses on competition, and the ways in which learning gives one organization an advantage over the other
- **Production management:** looks at the relationship between learning and organizational productivity and efficiency
- **Cultural perspective:** describes how organizational and national cultures are a significant cause and effect of organizational learning

- ***The learning organization***: concerned with implementation, and the characteristics of organizations which are able to effectively share and use knowledge to achieve organizational goals

The proliferation of different disciplinary perspectives leads to fragmented conceptualizations and distinct contributions on how we understand the nature and problems of organizational learning. According to Prange (1999), the multitude ways in which the notion of organizational learning had been conceptualised and used has created an ‘organizational learning jungle’ that is becoming more and more dense and impenetrable.

Due to disciplinary differences on the nature and problems of organizational learning; even a consistent definition of organizational learning has been elusive (Easterby-Smith 1997; Dodgson 1993). For example, Fiol & Lyles (1985) conceptualized organizational learning as the process of improving actions through better knowledge and understanding; whereas for Prange (1998), organizational learning is a process of individual and collective learning- both within and between organizations. Duncan and Weis (1979) in their part used the notion of organizational learning to show the process by which knowledge about action-outcome relationships and the effects of the environment on these relationships is developed. For Senge (1990) organizational learning refers to the continual expansion of the organization’s capacity to create its future; whereas Huber (1991) conceptualized it as the acquisition of knowledge by any of its units that it recognizes as potentially useful. Garvin (1993) in his part described organizational learning as the skill of creating, acquiring, and transferring knowledge and modifying its behaviour to reflect new knowledge and insights. Nicolini et al. (2003) on the other hand argued that “organizational knowledge and learning cannot be conceived as mental processes residing in members’ heads; ...rather organizational knowing is

situated in the system of ongoing practices of action in ways that are relational, mediated by artifacts, and always rooted in a context of interaction” (ibid, pp. 3).

Another source of distinction and debate within organizational learning literature is the question of which particular entities are capable of learning. As Baxter (2009) noted, there are different views with regard to this question. For example, there is a view that considers learning is an individual activity and argues that it is the individual within the organization who is the primary facilitator of learning in organizational contexts (see Levitt & March 1988; Huber 1991; Mumford 2001). Within this group, there are scholars who also treat organizations as learning entities. The second view on the other hand focuses upon the social and cultural aspects of learning and asserts that collective and social learning at all the levels of an organization is the predominant factor that resulted in learning (see Lave & Wenger 1991; Antonacopoulou 2006; Nicolini et al. 2003).

Given this lack of uniformity in how the notion of organizational learning is conceptualized and used across disciplines as well on the question of who learns; the current debate which is featured in organizational learning literature is around whether theorists should try to move towards a single integrated framework, or whether they should simply recognize that each discipline operates from distinct views of reality, and hence that a plurality of perspective should be seen as a strength (Easterby-Smith et al. 1999). With regard to this question, Easterby-Smith (1997) suggested that, due to the multidisciplinary nature of organizational learning and the diversity of purposes and perspectives; it is better to consider organizational learning as a multidisciplinary field containing complementary contributions and research agendas, rather than a unified body of knowledge and practice. Similarly, Robey et al. (2000) argued that, since organizational learning has diverse origins and due to its multidisciplinary nature, it is unlikely that a uniform understanding of the notion of organizational learning will ever be shared widely. To this end, they pointed out that, it is essential for researchers to identify their own conceptual constructs and specify their basic assumptions and approaches to answer questions such as: what does learning mean?, What are the levels of learning?, What are the learning mechanisms?, What are the outcomes of the learning

process?, and what are the barriers for learning? Other scholars (such as Huber 1991; Nicolini & Meznar 1995; Antonacopoulou & Chiva 2007), on the other hand, argue about the importance of the development of a comprehensive theory of organizational learning in order to deal with the large degree of fragmentation in the field. Giving a detailed account of the different disciplinary perspectives and understandings of organizational learning would go beyond the scope of this study. Rather, in subsequent sections, I present an overview of the debates on different perspectives of organizational learning in relation to the learning entities.

3.2 Acquisition vs. practice-based perspectives of Learning

Organizational learning researchers can be distinguished on the basis of their assumptions about the question of ‘who learns’ or their choice of the units of analysis (i.e. either the individual, group or organization learns). Perhaps one of the most debated issues in organizational learning research has been the unit of analysis. For example, some authors (e.g. March & Olson 1976; Nonaka 1994) make the relationship between individual, group and organizational levels of learning explicit, while others tend to focus only on the organization as the sole unit of analysis (Lant & Mezas 1992). There are also scholars (such as Levitt & March, Huber 1991) who consider learning as an individual level phenomenon and describe organizational level learning as individuals’ acquisition of information and knowledge, analytical and communicative skill (see Argyris and Schon 1978). Proponents of the organizational level of learning argue that the organization is the level where learning acquired through individuals and groups is institutionalized in terms of routines, rules, systems, and procedures. For example, Kim (1993) argues that organizations can learn independent of any specific individual but not independent of all individuals. Other scholars also took a similar view by accepting the organizational instead of individual aspect of learning while at the same time still claiming that individuals are the principal agents of organizational learning (see for example Duncan and Weiss 1979; Hedberg 1981; Huber 1991; Weick and Westley 1996). Fiol & Lyles (1985) in their part argued that though individual learning is

important to organizations, organizational learning is not simply the sum of each member's learning.

There are also scholars who argue that learning is a social phenomenon where learning occurs through participation and interaction of different groups and communities (see for example Lave & Wenger 1991, Nicolini et al. 2003). As such, the debate on organizational learning mainly relies on two main perspectives: acquisition (cognitive based) (see Cyert and March 1963; Argyris and Schon 1978, 1996; Levitt and March 1988; March and Olsen 1975; Simon 1991) and participation (practice-based) (see Lave and Wenger 1991; Brown and Duguid 1991; Cook and Brown 1999; Wenger 1998; Easterby-Smith 1997; Nicolini et al. 2003 Gherardi 2000, 2001, 2006; Pasteur 2004; Antonacopoulou & Chiva 2007) perspectives. The following sub-sections therefore, mainly provide an overview of the theoretical foundations of the cognitive and practice-based perspectives of organizational learning.

3.2.1 Acquisition Perspective of Learning

The acquisition perspective views learning as an acquisition of knowledge from external sources and integration of that knowledge in the organization's current knowledge base (Huber 1991; Senge 1990; Argyris and Schon 1996; Pedler & Aspinwall 1998). This perspective assumes that knowledge can be codified, stored and easily transmitted, and learning occurs when this knowledge is transmitted to individuals or embedded in the form of organizational rules and routines (see Cohen and Bacdayan 1994, Chiva and Alegre 2005). This conceptualization of learning, knowledge and their relationship within organizations is based on a positivist epistemology and fails to capture the multiple modes of knowing in action as social actors interact (Antonacopoulou and Chiva 2007). In this perspective, the focus is on identifying, noticing, and acquiring existing knowledge that exists tacitly or explicitly (Gnyawali 1999). As Elkjaer (2004) indicated, the acquisition perspective comprises an understanding of learning as an individual acquisition of knowledge, skills, and attitudes. She further stated that in the acquisition perspective "the mind is viewed as being a container, knowledge as a substance and learning is the transfer and addition of substance to mind" (Elkjaer 2004 pp: 419-20).

This form of learning, therefore, focuses on exploiting the already existing information and knowledge through training, instruction and formal education (Gherardi et al. 1998).

However, such approaches to knowing and learning significantly overlook the social and practical aspects of learning by conceptualizing knowledge as an object instead of process- that is as a mental substance mainly located in individual minds and manifested in written texts, representations and routinized behaviours (Gardner et al. 2003). For example, scholars (such as Kim 1993; Fiol and Lyles 1985) advocated approaches that conceive knowledge as the codification of experience in some form of cognitive structure or behavioural pattern, and of learning as the process through which such structures and patterns change. As such, enhancement of information processing and decision making in organizations is viewed as a process that can be improved by individuals' acquisition of relevant information and knowledge, which in turn can guide the organizational behaviour of individuals (see Senge 1991; Pedler & Aspinwall 1998). Accordingly, they equate individuals as entities that process information, reflect on experience, and in a way acquire knowledge. Those individuals and/or organizations that manage to change/modify their internal systems of beliefs and their actual or potential behavioural repertoires are said to have "learned" (Gardner et al. 2003). Elkjaer (2004) in her part noted that, in this perspective, learning is about how organizational members acquire knowledge on a particular phenomenon in the real world; and the knowledge to be acquired is already stored somewhere in different formats (such as books, databases human mind) to be used by people who needs it.

It is important, however, to acknowledge that there are some scholars (such as Greeno 1989; Hutchins 1995) within the cognitive tradition who challenge the narrow information processing view of the acquisition perspective (Marshall 2008). These scholars acknowledge the difficulties of conventional cognitive approaches and indicated their insights on the need to include a more situated and dynamic treatment of the social and practical aspects of knowing and learning.

Due to its focus on individual acquisition of skills and knowledge as its point of departure, the acquisition perspective of learning is also criticised by many contemporary scholars. For example, Elkjaer (2004) argued that “resting organizational learning upon the metaphor of knowledge acquisition is problematic with regard to understanding and explaining how it is possible to transfer an individual learning outcome to the organization” (ibid pp: 422). Building on the criticisms of the cognitive approaches, Marshall (2008) also noted that “...to the extent that cognitive approaches have relied on models of information processing, it is true that they tend towards a rather static, functionalist and ultimately individualistic portrayal of learning as the passive acquisition of knowledge” (ibid, pp: 414). Huysman (2000) in her part also noted that due to its emphasis on planned and goal oriented learning (as formal teaching and instruction), cognitive based learning perspectives are not suited to encompass situated learning. It is also criticized for its failure to explain how learning occurs at a collective level and how individual level learning is being transferred to the organization (Elkjaer & Huysman 2008). Moreover, the literature on cognitive perspective focuses on “planned and goal oriented learning processes and as such is not able to encompass the learning which often takes place as part of the lived day-to-day organizational activities” (Huysman & Elkjaer 2008, pp. 170).

3.2.2 Practice-based Perspective of Learning

The practice-based (participation) perspective challenges the main assumptions of the cognitive perspective of learning (Lave 1988; Brown et al. 1989) which assumes that learning takes place within the heads of individuals or organizational systems and structures (Easterby-Smith et al. 2000). The practice-based approach views learning as something distinct from the mere acquisition and assimilation of information and knowledge, it is rather a phenomenon situated in social practices (see for example, Lave Wenger 1991; Brown and Duguid 1991; Weick & Roberts 1993; Weick & Westley 1996; Cook and Brown 1999; Nicolini et al. 2003; Pasteur 2004; Gherardi 2000, 2001, 2006). In the context of organizational learning literature, such type of learning is often known under several names including ‘situated learning’ (Lave and Wenger 1991; Brown and Duguid 1991; Richter 1998), ‘Social learning’ (Elkjaer 1999; Sørensen 1998), ‘learning

as actual processes' (Cook & Yanow 1993; Henriksoon 1999, Yanow 2000) and as 'practice-based learning' (Gherardi 2000; Nicolini et al. 2003).

The implication of the practice-based perspective is that, learning is a social phenomenon that we only get knowledge about something in our social world through our participation and practice in that world. The main argument is that learning is not an activity that takes place within the heads of individuals or organizational systems and structures. It rather occurs, mainly through practice, participation, conversations and interactions between people (Brown and Duguid 1991; Gherardi and Nicolini 2002). The practice-based perspective of learning as such implies that individuals are social actors who together construct an understanding of what surrounds them and learn from the social interaction within social systems such as organizations (Gherardi et al. 1998). Learning, therefore, can only be achieved through active participation which is constantly being modified as a result of new events and challenges encountered by the group. To this end, Elkjaer (1999) argues that, the practice-based approach focuses on change, rather than on order and regulations. Instead of attempting to understand what type of cognitive processes or conceptual structures are involved in organizational learning, it attempts to explain which type of social context is more suitable for organizational learning, focusing on the group and the community, rather than on the mind of the individual (Antonacopoulou & Chiva 2007).

Practice-based learning takes into account everyday social activities while performing regular duties and tasks. As Gherardi et al. (1998) noted "... in everyday life as much as in work organizations, people and groups create knowledge, negotiating the meaning of words, actions, situations and material artifacts.... as such, learning is always a practical accomplishment" (ibid, pp. 274). Learning can, therefore, be seen as a form of co-participation in some form of the day-to-day tasks and practices of the workplace rather than the acquisition of abstract knowledge through training, instruction or formal education (Gherardi et al. 1998).

In the context of practice-based learning, the individuals' role as a learner is to be engaged in sense making (Weick 1995) - i.e. acquiring and influencing the development of knowledge within and among his/her trajectory of participation- but it is no longer just the individual who solely retains knowledge, rather knowledge exists within and among participating actors (Grey & Antonacopoulou 2004).

According to Marshall (2008), one important strength of practice-based approaches as opposed to the cognitive approaches is that: "they strive to offer an holistic understanding of knowing and learning as dynamic, emergent, social accomplishments that are actively situated within specific contexts of practice" (ibid, pp: 418). Moreover, unlike the cognitive perspective, this approach conceptualises context not simply as a static container within which activities occur, but "as crucially enacted, whereby its elements are simultaneously influenced on the medium and outcome of social activity" (Marshall 2008, pp. 419). As such, practice-based approaches would help to counter some of the drawbacks observed in cognitive approaches that tend to depict knowledge and learning in static, dualistic, internalized and ultimately individualized terms (ibid).

Since learning in practice-based perspective is not primarily tied to teaching and individuals' skills and knowledge acquisition but to learning in the social and institutional environment that makes up an organization; the notion of learning as participation embraces the organizational level of learning than the acquisition metaphor which is more of an individual phenomenon (Elkjaer 2004). The practice-based perspective, as such, offers analytical leverage to study and understand learning processes in social and institutional contexts. In line with this, Richter (1998) argued that this perspective provides an integrative and encompassing alternative framework to learning in organizational contexts. Unlike much of the cognitive based organizational learning literature, this perspective gives a central role to the interconnections and trajectories of participation and practice within communities or groups in which they take meaning, and therefore offers rich insights about the more subtle and mutually creating nature of the relationship between individuals, their work practices and their changing environments (Richter 1988).

However, the practice-based perspective has its own limitations. For example, it is criticized for ignoring the importance of tensions and conflicts as triggers to learning both at individual and collective levels (Mark & Poltrock 2004; Thompson 2005; Antonacopoulou & Chiva 2007); and it often perceives learning “as harmonious, free from conflict, tension and power issues” (Huysman & Elkjaer 2006 pp. 3). Besides, this perspective fails to elaborate on how it is possible to include mind and thinking in order to conduct theoretically informed actions (Elkjaer 2004). Thirdly, as Elkjaer (2004) indicated, “...the ‘how’ and ‘what’ of learning seem to disappear within the broader concept of learning as participation in communities of practice (ibid, pp. 420).”

Several scholars (including Sfard 1998; Gnyawali 1999; Elkjaer 2004; Huysman & Elkjaer 2006; Antonacopoulou & Chiva 2007; Skerlavaj & Dimovski 2007; Elkjaer & Huysman 2008; Marshall 2008) argue that adopting either the cognitive or practice-based perspectives in isolation will lead to see only part of the picture of what organizational learning entails. In order to bridge the differences between the cognitive and practice-based approaches and establish a meaningful dialogue between them, it is appropriate to develop analytical framework that combines essential attributes of the two perspectives (Elkjaer 2004; Marshall 2008). The ‘third way’ is such a theoretical lens proposed by Elkjaer (2004) and further strengthened by Huysman and Elkjaer (2006) and Elkjaer & Huysman (2008) as a new perspective to knowing and learning in organizational contexts. The ‘third way’ attempts to bring a meaningful dialogue between cognitive and practice-based approaches by conceptualizing organizations as social worlds held together by commitment to different practices, activities and values (Elkjaer 2005). This perspective is adopted in this thesis and the following section provides an overview about it.

3.2.3 The ‘Third Way’ as a new perspective to Learning

In spite of the differences on how cognitive and practice-based approaches understand individual and collective forms of learning; some scholars (such as Elkjaer 2004; Huysman & Elkjaer 2006; Antonacopoulou and Chiva 2007; Marshall 2008) argued that, the two perspectives are highly interrelated, and learning very often occurs through both of these processes (i.e. through cognition and practice) simultaneously. For example, Marshall (2008) pointed out that the two approaches are “by no means as incompatible as often claimed and that a fruitful dialogue can and should be established between them” (ibid pp. 418). Orlikowski (2002) also noted that knowing and practice are “reciprocally constitutive, so that it does not make sense to talk either knowledge or practice without the other” (ibid pp. 250). Similarly, Elkjaer (2004) and Huysman & Elkjaer (2006) proposed ‘the third way’ as an alternative approach to mediate the gap between the cognitive and practice-based perspectives. Elkjaer (2004) argued that the ‘third way’ is “an attempt to make a synthesis of the ‘second way’ of organizational learning with its understanding of learning as participation in communities of practice by including elements of the ‘first way’ of organizational learning, learning as acquisition of knowledge as well as analytical and communicative skills” (ibid, pp. 420). The basic idea behind her synthesis is:

“to acknowledge that thinking is instrumental in learning as participation and that learning takes place as a social process. The content and process of learning are, however, not ‘visible’ as in a chemical experiment. Rather, both the ‘what’ and the ‘how’ of learning have to be constructed by way of conceptual understanding of learning” (Elkjaer 2004 pp: 420).

The ‘third way’, as such, opens up the learning content from skills and knowledge acquisition or becoming skilful practitioner to experience and the learning method from skills and knowledge acquisition or participation in communities of practice to individual and joint inquiry or reflective thinking (Elkjaer 2004). By adopting the notions of experience and inquiry from the American pragmatist educationalist John Dewey (1859-1952), Elkjaer (2003) elaborated on the notion of inquiry as the overall creation of

individual and collective, cultural and historical knowledge as opposed to plain communication skills. Similarly, she elaborated the notion of experience “as a non-dualistic concept covering the individual and the world, and experience is always culturally mediated as opposed to viewing it as intrinsically physical, mental and private processes” (ibid, pp. 48). Experience and inquiry, therefore, “cannot be limited to mind or body, knowledge or emotion, thinking or action, but rather encompass all parts” (Elkjaer 2004, pp. 426).

Elkjaer (2004) in her ‘third way’ perspective, also re-conceptualized former understandings of organizations as systems (the acquisition perspective) or organizations as communities of practice (the practice-based perspective) and introduced a more pragmatic understanding of organizations as ‘social worlds’. Strauss (1991) citing Shibutani (1955) noted that “each social world is a universe of regularized mutual response; each is an arena in which there is a kind of organization; each is also a cultural area, its boundaries being set neither by territory nor formal membership but by the limits of effective communication” (Strauss 1991, pp. 233). The social worlds perspective, as such, understands organizations “... as being mutually constituted and constituting the systemic order of organizational actions and interactions kept together by individuals and groups commitment to organizational life and work” (Elkjaer 2004, pp. 421). The notion of group in this description involves all collective actors (be they formal organizations, group of people, or technologies) committed to act and interact within the social worlds (Clarke 1991, Huysman & Elkjaer 2006; Elkjaer & Huysman 2008). In social worlds, “various issues are debated, negotiated, fought out, forced and manipulated by representatives” of the participating social worlds (sub-worlds) (Strauss 1991, pp. 239). As it is pointed out by Strauss (1991) and cited by Huysman and Elkjaer (2006), organizations could be viewed as “arenas where in members of various social (sub) worlds take different claims, seek differential ends, engage in contest and make or break alliances in order to do the things they wish to do” (ibid, pp. 8). As Strauss (1991) indicated, social worlds “can be studied at any scale, from smallest (say local world, on local space) to the very largest (in size or geographic spread)” (ibid, pp. 421).

The social worlds perspective has also introduced agency as well as the notions of tensions conflicts as triggers for organizational learning (Clark 1991; Elkjaer & Huysman 2008); where agency is used to denote “various organizational actions and learning and how these are enacted by different kinds of agencies” (Elkjear & Huysman 2008, pp. 171), and tensions and conflicts as derived from different commitments to different actions, practices, and values (ibid). Another important concept introduced by the social worlds perspective is the notion of arena. An arena is a field of action and interaction among a potentially wide variety of collective actors (be it human, organizational or technical artifacts). In arena, the different social worlds that focus on a given issue and prepared to act in some way come together (Strauss 1978, 1991).

In describing things that exist at the junctures where varied social worlds meet in an arena of mutual concern, Star & Griesemer (1989) introduced the concept of boundary objects. Gal et al. (2004) noted that boundary objects are:

“... abstract or physical artefacts which reside in the interfaces between organizations or social communities and have the capacity to bridge perceptual and practical differences among diverse communities in order to reach common understandings and effective cooperation (ibid, pp. 194).

Boundary objects, therefore, serve as intermediaries (interfaces) between multiple social worlds and facilitate the interaction, communication and flow of information, concepts, skills, and materials between diverse social actors (Fujimura 1992, Roth & McGinn 1998). Since it has been used by Star & Griesemer (1989) for the first time, the notion of boundary objects has been applied to denote different things including physical product or prototypes (e.g. Bechky 2003, Carlie 2002), design drawings (Bødker 1998), shared IS (Briers & Chua 2001; Pawlowski & Robey 2004), engineering sketches (Henderson 1998), and standardized forms (Bowker et al. 1995; Briers & Chua 2001).

Star and Griesemer (1989) argued that, certain boundary objects are flexible enough to accommodate different interpretations or interests emanating from various distinct social worlds, yet robust enough to maintain a common identity across all social contexts, thus

allowing translation to take place across the boundary. As such, the process of developing and adapting boundary objects (such as technical artifacts or standardised data collection tools) through the actions and interactions of stakeholders from different social worlds, “is fundamentally an exercise in negotiated order and a robust boundary object achieves this status by satisfying both the particular, local demands of users and the wide arena demands of all the worlds involved” (Clarke 1991, pp. 134).

Through “negotiated order” (see Strauss 1978; Clarke 1991; Thomas 1984; Modell 2006) participants in social worlds generate, adopt, or adapt new standards, tools, technologies, ideologies and work practices. The notion of negotiated order as it is used in social worlds theory (Strauss 1978, 1991; Clarke 1991) provides a useful analytical insight to understand ongoing negotiations between different actors and how social orders emerge as a result of the give-and-take interactions that are predefined by formal rules, norms, laws, or expectations (Clarke 1991). The notion of negotiated order also helps to recognize that social structures are products of human agency and a conditioning factor for the interplay between different social actors with overlapping and competing interests (Strauss 1978; Fine 1984). This interplay between human and institutional actors from different social worlds is an on-going process of negotiation involving issues of varying clarity and complexity (Modell 2006). Through this on-going negotiation and re-negotiation, new organizational practices, standards, rules and norms will emerge. In line with this, Modell (2006) argued that “what are considered institutional rules at any specific point in time may be viewed as a product of past negotiations whilst these may be re-negotiated if the negotiation context is amenable to change” (ibid, pp. 222).

The ‘third way’ perspective, by introducing the notion of social worlds and the associated concepts of tension, conflicts, negotiated order and boundary objects seems a suitable theoretical lens to:

“...look at actions, activities and values as a collective endeavour and to include both agency (commitment to organizational action) and learning through the existence of tensions and conflicts between and within organizational social worlds. It provides the image of organizations as negotiated orders and

organization learning as a process of negotiation (including conflicts) between different voices or social worlds” (Huysman & Elkjaer 2006, pp. 3-4).

Summary of the three (i.e. cognitive, practice-based and the third way) perspectives of organizational learning in terms of their learning content, learning method, relationship between individual and organization, and how organizations are understood as it is exhibited by Elkjaer (2004) is presented in table 3.1.

Table 3. 1: *Three Perspectives of organizational learning (as presented by Elkjaer, 2004).*

	<i>The First Way</i>	<i>The Second Way</i>	<i>The Third Way</i>
<i>Learning Content</i>	To be skilled and knowledgeable about organizations	To become skillful practitioner in organizations	To develop experience as part of a continuous transaction between individuals and organizations
<i>Learning Method</i>	Acquisition of skills and knowledge	Participation in communities of practice	Individual and joint inquiry or reflective thinking, begins with body, emotion, and intuition
<i>Relation between individual and organization</i>	Traits and possible to separate in analysis and practice	Individuals as part of communities of practice	Transactional – mutual formation of individuals and organization
<i>Organization</i>	System	Communities of practice	Social worlds

As it is presented in the introductory chapter of this thesis, the social worlds approach has been adopted as analytical lens to understand the complex dynamics of knowing and learning in developing and implementing computer-based HIS in public health settings of

developing countries which is mainly characterised by diversity of stakeholders, multiplicity of institutional practices, and scarcity of resources (human, financial and infrastructural). This approach had been adopted mainly due to its strength in treating organizations as arenas for collective coordinated action; learning as a negotiated order triggered by tensions and conflicts due to differences in commitment, interest and values; and different actors (individuals, groups and organizations) as learning entities that interact and negotiate through various boundary objects. The following sub-section (section 3.4) the theoretical framework of this study by conceptualizing HIS development and implementation as negotiated order across multiple social worlds and sub-worlds.

3.4 HIS development and implementation as negotiated order

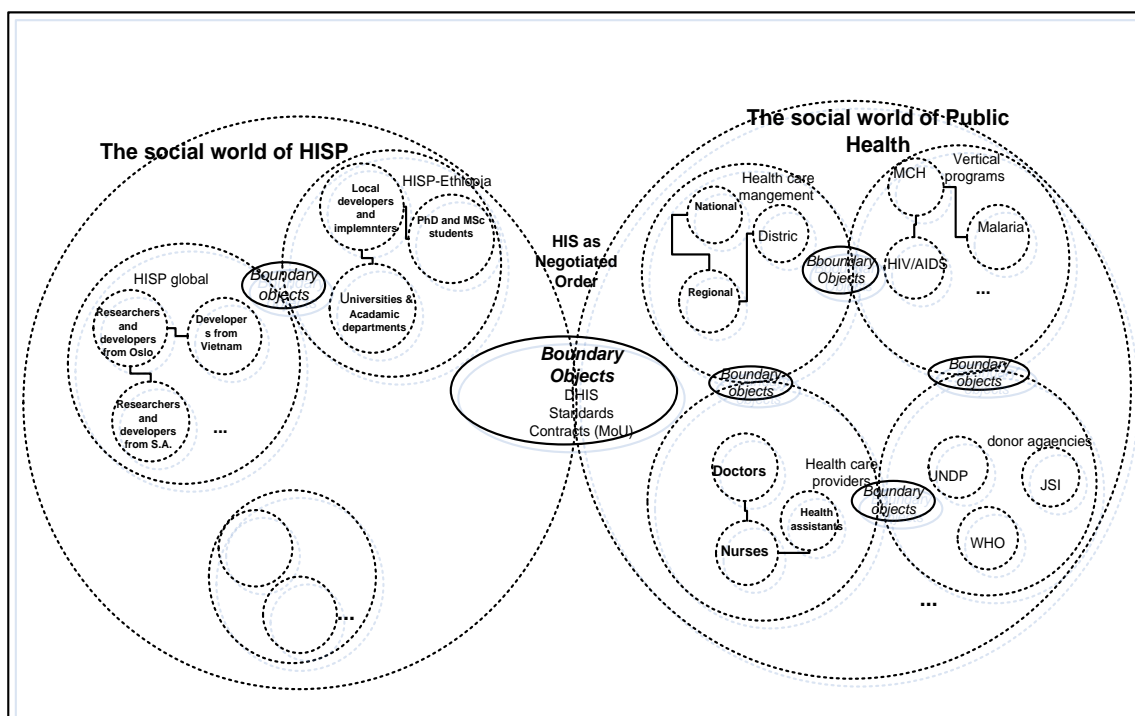
In the context of this thesis, HIS development and implementation is conceptualized as a dynamic process of learning across multiple social worlds. More specifically, I argue that, the process of designing, developing, customizing, and implementing computerized HIS is not a mere process of developing technical artefacts based on some basic technical skills and know-how, it is rather a process of mutual & interactive learning that involves actions, interactions, and negotiations of diverse human and organizational actors from multiple social worlds (sub-worlds) mainly from the public health and IS domains. This interaction and negotiation of multiple actors from various social worlds is mediated through boundary objects (such as technical artifacts and standards). Strauss (1978) and other scholars (such as Clark 1991; Thomas 1984; Modell 2006) described this process as “negotiated order”.

The process of developing, adapting and implementing computerized HIS in public health institutions through the actions, interactions and negotiations of different actors is a ‘negotiated order’ (Strauss 1978, 1984, 1991; Clarke 1991; Model 2006; Fine 1984; Rahman & Lawrence 2001); which is mainly mediated by variety of boundary objects including technical artifacts (such as DHIS), standards (standardized data collection tools and reporting formats), contracts (such as memorandum of understandings), and instruction materials (such as user training manuals).

However, introducing new systems and standards is often fraught with conflicts and tensions. This is mainly due to multiplicity of work practices, complexity of organizational structure and functional areas, and heterogeneity of institutional and human actors that are involved in the process of introducing change to existing systems, tools, standards and work practices of health management information systems in many developing countries. As Pawlowski et al. (2003) indicated identifying and including multiple stakeholders as well as integrating and reconciling their perspectives and interests in the process of IS design and development is central to make the system more operational and useful to users after its initial deployment. Each group come up with its own sets of interests, attitudes, practices, and values and would like to inscribe it in the new system or standard. On the other hand, the design and development of technical artifacts (such as DHIS) and standards (such as essential data sets and reporting formats) carries its own complex socio-cultural and historical activities, practices, rules, and conventions. Tensions and conflicts arise when existing practices, standards and routines are challenged by a group of actors who have different interests, commitments, or values; or when new technical artifacts, tools or systems are introduced. Addressing these tensions and conflicts requires continuous interaction and negotiation of stakeholders from the participating social worlds and sub-worlds. It is through this interaction and negotiation that individual and collective actors learn and develop common ground on essential data sets, reporting formats, layout and functionalities of the software and new work practices.

For the purpose of this study, as it is presented in figure 3.1 below two main social worlds (i.e. the social world of HISP and the social world of public health care system) has been identified. Each social world in turn constitutes a variety of distinctive sub-worlds that interact, communicate, negotiate, and take actions on a number of issues in the process of designing, customizing and implementing computerised HIS.

Figure 3. 1: A model of interacting social worlds (sub-worlds) in HIS development and implementation



In the HISP social world, for example, there are the sub-worlds of HISP-Ethiopia team members (which involves different human and non human actors such as: different versions of DHIS software, local software developers, MSc and PhD students, academic institutions); and HISP-international (including: DHIS software, global developers, researchers, funding organizations such as NORAD). There is always inter and intra sub-world interaction , communication and negotiation on a variety of topics, problems and challenges including: technical competency and knowledge on different development tools and technologies; practical problems related to incorporating new modules (such as morbidity and mortality module, import-export module), how to scale the system both

geographically and functionally, and develop a common understanding on a variety of topics including technological choices and implementation strategies.

The public health social world, on the other hand, constitutes diverse sub-worlds including: public health management at different levels (district, regional, national), health care institutions (hospitals, health centres, and clinics), practicing medical personnel (physicians, nurses, and health assistants), vertical health programs and services (MCH, HIV/AIDS, TB, and Malaria etc), donor agencies (such as WHO, UNDP, UNICEF, JSI). Even within the same social world, there are different sub-worlds which pursue their own agenda and interests beyond the interest and agenda of the bigger world. For example, with in the public health social world, there are several vertical health programs with their own structure, data collection tools and standards, and work practices. Each vertical program again consists of other sub-worlds at district, regional and national levels that interact and negotiate on several issues including data collection and reporting formats, frequency of reports, and content of reports. There is always interaction, communication, collaboration, and negotiation within a given social world and between sub-worlds on a variety of issues and topics including reports, data collection formats, essential data sets, integration of health programs, standardization of work practices and routines.

It is also essential to note that people often could be members of multiple social worlds (sub-worlds) (Mark & Poltrock 2004) when they are involved in different tasks and work groups at a local or national or global level, and act as bridges between the different social worlds (sub-worlds) which they are involved. For example, a head of a particular vertical program could be assigned to a work group established to standardise regional data sets and reporting formats in collaboration with other vertical program managers, planning and programming unit, IS experts and other stakeholders. Participation of an individual actor in two or more social worlds (sub-worlds) simultaneously puts her/him to assume different roles but at the same time gives her/him an opportunity to deal with tensions and conflicts by balancing the interests, demands and goals of the two social worlds. It is in the process of addressing such tensions and conflicts through interaction

and negotiation that s/he develops new insights, new understandings and new meaning on a given topic or problem and helps others to learn and address internal conflicts and tensions in his/her sub-world. Similarly, a developer could be a member of both global and local development team, as well as a member of work group working on standardization of data sets and reporting formats at regional and national levels. S/he also can serve as a mediator to establish meaningful communication between the different social worlds and sub-worlds interacting and negotiating on different issues and problems.

The environment in which the social worlds operate also had significant impact on the outcome of technology adoption as well as standardization process. As Mark & Poltrock (2004) noted the social worlds environment consists of its structure (i.e. hierarchical or networked, distributed or collocated), policies (i.e. rules and standards governing the interaction and communication process), and availability of infrastructural, human and financial resources. The social worlds identified in this thesis are diverse and complex where each social world and sub-world has a unique constellation of work groups, practices, structure, resources, and tasks. For example if we take the social world of public health system, it is characterized by diversity and complexity whereby the entire system is structured hierarchically in terms of regions, zones, districts, and health facilities. At each hierarchical level, there are different organizational and environmental conditions involving different vertical programs, management team members, health workers, work groups, and tasks.

Unlike traditional organizational settings, the social worlds (sub-worlds) identified in this thesis have fluid boundaries which are connected not in terms of fixed organizational boundaries, but through effective communication (Mark & Poltrock 2004; Fitzpatrick et al. 1996). As such the notion of boundary is used in the sense of work and use contexts than physical organizational boundaries. Work practice boundaries are “seen as constituted in the situated actions of members of a social world sharing some commitment to collective action” (Fitzpatrick 2000 pp.140). Distributed development teams within the HISP social worlds is an example of such work practices where

developers distributed across different countries undertake their tasks through communication and interaction using different mechanisms (including group mail, group wiki, seminars and workshops). As the technology (i.e. DHIS) pass through different social worlds (sub-worlds) across geographic distance for example, from one HISP member country to another or from one region to another in the same country, it is appropriated and shaped through a process of local adaptation customization and local learning of different stakeholders in different settings and contexts.

Given the diversity of perspectives, heterogeneity of stakeholders, and the tensions and conflicts emanating from these different perspectives in the process of adapting and implementing existing routine paper-based HIS; boundary objects (such as technical artifacts or standards) can serve as mediating devices to facilitate the interaction, negotiation and collaboration of different stakeholders across different social worlds. As Wenger (2000) indicated, in such contexts, boundary objects could serve as essential collaboration and learning tools mainly for two reasons. Primarily, they connect heterogenous actors from multiple social worlds; and secondly, they offer learning opportunities in their own right (ibid). Similarly, in this thesis, boundary objects (such as DHIS and standards) are used as tools to mediate the interaction and negotiation of diverse actors across distinct social worlds and sub-worlds. In the process of this interaction and negotiation, stakeholders understand each other's viewpoints and ease tensions and conflicts through negotiation and mutual learning. Learning is the result of these interactions and negotiations around the boundary object. The following sub-sections provide an example on how DHIS software and standards serve as boundary objects to facilitate the interaction and negotiation of different stakeholders within and between the HISP and public health social worlds.

- **DHIS as Boundary Object**

Technological artifacts (such as DHIS) can serve as boundary objects that help to break knowledge barriers between practices and facilitate mutual learning in multiple contextual environments (Carlisle 2002); or to trigger transformational learning for the creation of new practice-based knowledge (Engestrom 2004). In line with this, Jensen &

Markussen (2007) argued that “technology is central to work, cognition and learning: that the technological environment in which we work cannot be separated from what and how we learn” (ibid pp. 204). In the context of this thesis, the district-based health information software (DHIS) has been used as boundary object to mediate practices, cognition, and learning among system developers and implementers within the HISP social world and between the social worlds of the public health care system (including managers, health workers, vertical programs and donors). Within the HISP social world, the artifact served as a communication, interaction and negotiation object between local and global IS developers as well as among local HISP-Ethiopia team members. The artifact served as a boundary object by mediating developers from different countries to collaborate and learn in the process of developing different modules and functionalities. It also serves as a boundary object to mediate the interaction and negotiation of local developers and implementers as well as facilitators to work and collaborate around the artifact on different issues including the functionalities of the system, modules required to be developed or customized in different settings, skills required to develop modules, how to develop modules, how to get support from global development team, on implementation strategies, challenges encountered in implementing the system and so forth.

As a technical artifact, DHIS also serves as a boundary object to mediate interaction and communication between system developers and the public health domain experts (including managers, health workers, vertical programs, donor agencies) at different levels. It provides a forum for mutual engagement and learning, in identifying and diagnosing the problems of existing routine health information system at different levels of the public health care system, as well as in appropriating the technology to meet local needs through mutual engagement and learning. Very often, the artifact has been used to initiate negotiations between health care managers and the HISP-Ethiopia team members at a national level as well as with different regional health bureaus. For example, at the time when HISP was initiated in different pilot regions of Ethiopia, a prototype of DHIS software was used to attract the interest of different stakeholders (including regional health bureau heads, program managers, planning and programming department heads)

and to establish meaningful interaction and learning on the potentials of the software to improve their day-to-day routine practices of data collection, analysis and reporting. Developing a prototype and customizing the system, however, demands several consultations and discussions with the domain experts to understand about the data sets, report layouts, and interfaces required by the end users. When the system is demonstrated to the end users, the users also give feedback on the functionality of the system and appearances of reports. In this process, both the development team and the end users go through an interactive learning process.

Training around the technology is also another learning mechanism that allowed different stakeholders from both the HISP and public health social worlds to take part in mutual learning and interaction process. The technology plays an important mediation role in supporting the interaction and negotiation process. For example, while implementing DHIS software across different health care institutions, training of health workers, statisticians and managers on basic computer applications (such as MS Windows, MS-Excel and Ms-Access) as well as on the functionalities of DHIS software was used as a means to strengthen their competency in health information system management and use. The training had created an excellent opportunity for increased awareness and participation of the domain experts and users of the system to better understand the system and put forward their comments on problems they observed (such as the report layout, the interface of the system and the data entry forms). Likewise, the training also created an opportunity for the development and implementation team to understand the requirements of the users in a practical and interactive session. Similarly, the HISP-Ethiopia development and implementation team have also participated in in-house training sessions on DHIS development tools and technologies including Java frameworks by local developers as well as global partners mainly from Oslo and Vietnam.

Each instance of local negotiations between the participating social worlds paves the way to establish common ground on approaches and strategies of using the artifact as a means to deal with existing challenges of fragmented data, extreme work load of health

workers, and lack of information for action at different levels. Through the process of interaction, communication and negotiation, the technological artifact becomes an integral part of the daily routines of different actors from different social worlds, and thereby successfully connects multiple, even opposing perspectives. Besides, the interaction, communication and negotiation of different actors from different social worlds and sub-worlds while customizing and implementing the artifact creates diverse opportunities for mutual and interactive learning. However, as Wenger (1998) pointed out, different actors participating in such process of building boundary objects contribute and benefit differently, depending on their role and level of participation in their social worlds and sub-worlds.

- **Standards as boundary Objects**

Star and Griesemer (1989) argued that standards are boundary objects “devised as methods of common communication dispersed across different work groups” (ibid pp.411). Building a shared understanding about new standards and data collection tools in the public health care sector is a challenging task mainly due to the heterogeneity of actors and their interests, values and work practices. It often does not come up front; rather it evolves incrementally and collaboratively during long-term and complex negotiations of different actors from distinct social worlds and sub-worlds. Standards, when they are jointly developed by participating social worlds, they could serve as boundary objects to facilitate the communication, coordination and integration of the routine tasks of public health data collection, analysis, and reporting at different levels of the public health care system. As Koskinen & Makinen (2009) noted, developing these types of boundary objects demands different stakeholders to communicate with and learn from others who have different perspectives and perhaps a different vocabulary in expressing their views and ideas. As such standardized data sets and reporting formats serve as structured and institutionalized boundary objects which are intended to mediate different and conflicting interests and work practices. In the context of this thesis, the empirical findings revealed that standards serve as boundary objects both at the initial stages of their development and at the stage of their use. At the stage of developing them, different stakeholders (including health managers of different health programs, donor

agencies, and health care providers) interact and negotiate to define the essential data sets (at national and regional levels) and develop standardized data collection and reporting tools at different levels of the health care system.

However, developing standards of essential data sets and reporting formats in public health settings of developing countries is complex process fraught with tensions and conflicts between different actors from different social worlds including vertical health programs and services, national ministry of health, and regional health bureaus. For example, the standardization process requires integration of data items and reporting formats of different vertical programs. But very often vertical health programs are against integration and often inclined to maintain their own data sets and reporting formats. The national ministry of health (particularly the planning and programming department) on the other hand pursues the agenda of developing an integrated data collection and reporting format at all levels. At the lower level, the regional health bureaus and the districts as well as health facilities are forced to meet the requirements of both vertical health programs and the national ministry of health in the types of data they collect and report, and the data collection tools and standards they use. Developing standards, is therefore, a process of balancing these conflicting interests and views and coming up with an integrated essential data sets and reporting formats through ongoing interactions and negotiations of the multiple actors from the different social worlds.

For example, in the context of this study, the researcher closely followed and in some cases participated in the process of developing standards for different regional states in Ethiopia (mainly Addis, Amhara, and Benishangul-Gumuz). In most cases, even preparing the first draft of the standard took several months of discussion, negotiation and interaction among different actors through several workshops (involving actors from regional health bureaus, vertical health programs, representatives from districts and health facilities) and meetings with different specialized teams. Participation, in this process, creates a wonderful learning opportunity for both the HISP-Ethiopia team members and public health domain experts to explore on how health data is collected and

reported, the type of data collected, how vertical programs function, how the fragmented systems of vertical programs are integrated and how they can be implemented in practice.

Once the standards are developed as a result of the negotiations and mutual learning of participating actors, those standards would in turn be used as objects to mediate the smooth flow of communication and information flow between different levels of the public health care system.

Summary of the theoretical framework:

The main theoretical theme of this thesis is that introducing change to existing standards, systems, technologies and work practices in public health care settings of developing countries is a negotiated order that involves multiple stakeholders from distinct social worlds and sub-worlds. Besides, due to diversity of actors, interests, values, and practices; there are always tensions and conflicts between interacting actors which often is mediated through boundary objects. Learning is, therefore, triggered by the tensions and conflicts where different actors learn individually or collectively from their interaction and negotiation in addressing the tensions and conflicts. Learning through this process of interaction and negotiation, I argue, is the result of individual cognition as well as the situated and practice based learning of each and every participant. For example, the process of standardizing existing data sets and reporting formats is influenced by pre-existing knowledge, beliefs, and experiences of different actors participating in the standardization process; but participants also come up with new forms of meaning and understanding derived from their involvement in situated practices and collective actions.

The notion of social worlds has also been used as useful analytical tool in “capturing and describing the multiple simultaneous organized actions of individuals, groups of various sorts and formal organizations” (Clarke 1991, pp. 131). The ‘social worlds perspective, therefore, brings the relation between individuals and organizations to the fore and also opens up an understanding of the organization as neither a system nor communities of

practice but as social worlds held together by commitment to organizational situations, actions and events (Huysman & Elkjaer 2006). Unlike the cognitive or practice-based perspectives; in the social worlds perspective, learning is treated as something that involves individual cognition and collective activity of group of actors that are bounded by common goals and commitment to organizational actions. As such, in this thesis a distinct analysis of individual, group or organizational levels of learning was not made. Rather, learning has been addressed as a social process where participants from the different social worlds always construct new internal meaning and understanding based on their actions, interactions, and negotiations within and between multiple social worlds and sub-worlds.

This thesis has also attempted to explore the implications of local and situated learning developed through the interactions and negotiations of different stakeholders from multiple social worlds in dealing with the challenges of cultivating the installed bases of existing systems, technologies, standards, and work practices in different settings of the Ethiopian public health care system, as well as in scaling new initiatives, experiences and best practices to new contexts and in sustaining them at a local level over time. The following sub-section, therefore, presents a discussion on the implications of learning to the notions of installed base cultivation, scaling and sustainability in the context of developing and implementing HIS.

3.4.1 How Learning helps to deal with the challenges of installed base cultivation, scaling, and sustainability

The cultivation approach mainly focuses on strategies of managing change through gradual expansion, improvement, and replacement of the installed base which is mainly characterised in terms of existing systems, standards and tools (see Hanseth and Monteiro1998; Hanseth & Lyytinen 2004; Aanestad 2002; Dahlbom and Janlert 1997). Cultivation, therefore, emphasizes on the importance of what already exists (the installed base) with the implication that nothing can be designed from scratch, rather should be built by taking into account what already exists (in terms of systems, standards,

technologies, work practices, and routines) through incremental improvements and extensions (Hanseth et al. 1996; Monteiro 1998; Hanseth & Aanestad 2003; Hanseth 2002,). In the context of this thesis, the cultivation approach is understood as a gradual and step-by-step learning process that allows actors from different social worlds to understand the situation properly and introduce changes based on their understanding of the existing situation, skills and competencies at a local level.

I argue that cultivating the installed base of the existing HIS at a local level through negotiation, interaction, mutual understanding and shared vision gives a learning opportunity to understand the challenges of customising as well as changing the installed base and coming up with appropriate strategies to tackle those challenges. The cultivation process would in turn influence and shape the skills and knowledge of individuals and collective actors engaged in the process of developing, customising, and implementing the HIS at different levels of the public health care system. Cultivating the installed base (the existing HIS in this case) would also create an opportunity for mutual learning by allowing different stakeholders to come together and interact, discuss, and take action on different topics, strategies, challenges, and solutions. More specifically, I argue that due to the heterogeneous and complex nature of HIS (with diverse human and institutional actors, health programs, data sets, reporting formats, hardware, software, standards, work practices, work procedures, etc.) conceptualizing installed base cultivation as a learning process would give a new perspective to better understand the change and the specific learning processes, the learning mechanisms employed, and the learning outcomes at different levels and stages of the cultivation process. Learning, therefore involves the challenges of cultivating the installed base in terms negotiating and balancing between the inertia of the installed base (rigidity) and introducing change (flexibility) at a local level.

In recent days, the notion of scaling has been applied in IS research to describe the processes and challenges of extending the scope, functionalities, number of users, institutions and infrastructure of an IS beyond a pilot stage (see Monteiro 1998; Braa et al. 2004; Sahay & Walsham 2006; Shaw et al. 2007; Braa et al. 2007b). More

specifically, Sahay and Walsham (2006) drew upon an information infrastructure (II) perspective to analyze the challenges of scaling HIS in the context of developing countries and defined scaling as “...a process through which a product or process is taken from one setting and expanded in size and scope within that same setting and/or also incorporated within other settings” (ibid, pp. 185). As such, scaling is not only about spreading technological artefacts, but also involves reproducing and translating the necessary learning processes along with the spreading of technical artefacts, tools, processes, and know how (Braa et al. 2004).

Learning is an essential tool to understand the local context properly (i.e. in terms of availability of infrastructure, manpower required to handle the system and managerial commitment and support towards the system) before making a decision to scale the system to other geographical settings or to incorporate new functionalities to the system. People also learn from the scaling process and use that knowledge and experience to address new and emerging challenges at that particular setting or in other settings. As Lewis (2008) pointed out, scaling is not about reaching a level of critical mass but to make the different stakeholders learn to work and share experiences together, thus enabling broader networks to grow forth. In such a way, scaling also creates a learning opportunity among different actors by bringing new people, new insights, new experiences, new institutions, and new technologies, tools, and systems into the network of local and global actors whereby those actors would communicate, negotiate, and share experiences about a variety of issues and challenges. Through learning process, different stakeholders from both the HISP and public health social worlds develop expertise where increased usage of systems, tools and standards contributed to new skills, knowledge, and experience among managers, health workers, system developers, and implementers which in turn provides a basis for further improvement of the system technically and functionally as well as in scaling it to new settings geographically.

The term sustainability has different meanings when applied in different domains and contexts. Often, it implies maintaining something that already exists over time, or it may be equated with ‘self-sustaining’ and ‘self-sufficiency’, which means that no outside

support is required to continue its existence (Reynolds and Stinson, 1993). In the context of IS development and implementation, the notion of sustainability has been used by different scholars to deal with challenges of making an information system work in practice at a local setting (Braa et al. 2004; Korpela et al. 1998; Kimaro and Nhampossa 2005). Korpela et al. (1998) defined the term sustainability as the ability to identify and manage risks threatening the usability of the IS in advance. In this thesis, I argue that efforts to make HIS sustainable at local level are enhanced through the process of learning, negotiation, sharing of knowledge and best practices, and engaging people in their multiple roles as individuals, and as members of groups and organizations.

Learning, therefore, can support the sustainability and long term viability of HIS initiatives by creating an environment for on-going and sustained process of communication, negotiation, sharing of best practices and experiences between multiple actors from different social worlds. Learning can also heavily contribute to sustainability of HIS reform initiatives by creating a conducive environment to build the capacity of those individuals and groups involved in designing, developing, implementing and using the HIS at different levels to perform their tasks and sustain the initiative at a local level.

CHAPTER FOUR

Presentation and Analysis of Findings

4.1 Research Articles included in the Thesis

This chapter presents summary of the findings from the articles in the thesis and synthesis of how those findings contribute to the broader research questions posed in the introductory chapter of this thesis. The research articles have been published and under review in different conference proceedings and peer reviewed international journals. As such, in the following section, I present the complete reference of the papers (as presented in the appendix of this thesis) and provide a brief summary of each of the articles in the subsequent sections. Then, analysis of the findings and their inter-linkage in answering the proposed research questions is presented.

- I. Mengiste, Shegaw A. (2005). Challenges and opportunities of Implementing District-based Health Information System in Ethiopia: A Case Study from Benishangul-Gumuz Region. In Bada, A. & Adalakun, O. (eds.). *Proceedings of the IFIP W.G 9.4- Working conference on enhancing human resource development through ICT*. Abuja, Nigeria. pp. 256-267.
- II. Shaw, V.; Mengiste, Shegaw A.; Braa, J. (2007). Scaling of Health Information Systems in Nigeria and Ethiopia- Considering the options. In: Silva, L; Westrup, C. and Reinhard, N (eds.). *Proceedings of the IFIP W.G 9.4 on social implications of computers in developing countries*. Sao Paulo, Brazil.
- III. Kimaro, Honest C., Mengiste, Shegaw A. & Aanestad, M. (2008). Redesigning Health Information Systems in Developing Countries: The Need for Local Flexibility and Distributed Control. *Journal of Public Administration and Development*, 28: pp. 18-29.

- IV. Mengiste, Shegaw A. (2009). Analysing the challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies. *Journal of health informatics in Developing Countries* (under Review).
- V. Mengiste, Shegaw A. & Aanestad, M. (2009). Understanding the Dynamics of Learning Across Social Worlds: A Case Study from introducing IS into the Ethiopian public health care system. *Information and Organization* (revised and re-submitted).

The papers were written at different stages of my PhD trajectory and reflect the maturity of the theoretical focus as the research progressed. As such, each of the papers provides different empirical examples and conceptual insights and ideas that are pertinent to the research aim of this thesis. The following sub-section presents a brief summary of the findings of each of the papers. Following the summary, a synthesis of the inter-linkages of the findings and how they contribute to the broader research questions of this thesis is presented.

4.1.1 Paper one: “Challenges and Opportunities of Implementing District-based Health Information System in Ethiopia.”

This paper investigates the challenges and opportunities of designing and implementing computerised HIS in one of the most remote and disadvantaged regional states of Ethiopia (Benishangul-Gumuz). The paper reports based on situational analysis of the existing paper-based HIS in terms of structure, flow of health data, reports, availability of skilled manpower, and existing physical and ICT infrastructure and the challenges that influence the design and development of sustainable and scalable HIS across different levels of the public health system in the region. A multi-level analysis (that includes the regional health bureau, zonal health departments and district (woreda) health offices) was conducted.

The challenges of making the system sustainable involves issues related to shaping and adapting the system (in this case the district health information software (DHIS)) to meet

the requirements of the regional public health care system, cultivating local learning process, and institutionalizing new systems, standards, tools, technologies, work practices and routines of use that persist over time. The scaling challenge on the other hand is related to the problem of making one working solution spread to other settings and be successfully adapted there. Drawing on the notions of sustainability and scaling, the paper explored the challenges that could hinder the implementation process and opportunities that could be maximised to successfully scale the system to different settings and ensure its sustainability in the new setting over time.

The findings of this paper revealed that relevant constraints and challenges are mainly related to: existing structure of HIS (vertical and top-down structure), lack of flexibility in changing existing standards and routines, lack of skilled manpower to work on HIS related activities, a general trend of poor information use culture among managers and health workers at different levels, and poor infrastructure (both physical and digital).

The paper also identified possible strategies to deal with those constraints and challenges. For example, to deal with sustainability challenges, the paper identified the following strategies:

- Develop the system by following a bottom-up, incremental and participatory approaches;
- Create a conducive environment for strong collaboration, partnership and learning among different stakeholders including health care workers, managers, IS professionals, researchers, and donors;
- Develop local competency, skill and knowledge among health workers and managers in health information analysis and use, standardization of data collection tools, work practices and routines, and the application of computers for data capture, analysis and reporting.

To deal with scaling challenges, the paper identified the following strategies:

- Link HIS development and implementation with education, research, and sharing of best practices;

- Develop local capacity in terms of data analysis and use of technical artifacts through training and participatory learning;
- Introduce the flexible standards approach (see Braa & Hedberg 2002; Braa et al. 2004) to allow different health care institutions at different levels to define and use their own data sets as long as they include the data in their next higher level;
- Ensure the spread of local interventions and learning in the form of artefacts, tools, methods, best practices and knowledge across different nodes.

The paper also identified potential opportunities (including willingness and motivation of top management of the regional health bureau to support the reform process, collaboration and support of health workers and lower level managers towards the new system etc) that should be leveraged and cultivated by all parties involved in the change process more specifically by HISP team members.

Overall, this paper is the reflection of the interaction, negotiation and mutual learning of HISP-Ethiopia team members and the domain experts (including managers and health workers) from the regional, zonal and district health offices. The paper identified specific challenges and opportunities for mutual learning between participating stakeholders at different stages of the HISP initiative in the region. For example, when the project was initiated in the region, a memorandum of understanding was signed between HISP and the regional health bureau, which gave the mandate for HISP to customize and implement DHIS across different levels and collaborate on the development of the regional data sets and standardized reporting formats. The HISP- Ethiopia team members use this opportunity to introduce DHIS and the standardized data sets and reporting formats that has been developed for Addis as boundary objects to initiate the customization and standardization process in Benishangul-Gumuz regional state. Then, a prototype of DHIS software was presented to stakeholders (from regional, zonal and district health offices) in a workshop held in July 2004. Demonstration of the software ignited a strong interest towards the system and the software served as a boundary object to facilitate further negotiations and discussions on how the system is to be customized to cater to the needs of the regional health bureau.

Besides, the standardized data sets and reporting formats that have been developed for Addis Ababa health Bureau was used as a point of departure to standardize the regional data sets and reporting formats. However, the process of developing the regional data sets and reporting formats was not a harmonious process; rather it was fraught with tensions and conflicts mainly in relation to which data elements to be included, which items to be eliminated from each vertical program, availability of resources including manpower to handle the system and so forth. These tensions and conflicts created an opportunity for the stakeholders to further negotiate on these issues and develop a common ground on the importance of developing the regional data sets and standardised data collection and reporting tools. On the other hand, the HISP-Ethiopia team members learn a lot from their interaction, communication and negotiation with different stakeholders on the challenges and opportunities that are specific to the region. The different strategies that are proposed in this paper are therefore, results of such learning process.

4.1.2 Paper two: “Scaling of health Information Systems in Nigeria and Ethiopia-considering the options”

In recent days, some scholars (see for example Sahay and Walsham 2006; Braa et al. 2004; Braa et al. 2007a) argue that IS should be designed in a manner that allows it to be scaled through an evolutionary process. Similarly, in this paper we build on the concept of cultivation (Dahlbom and Janlert 1997; Hanseth and Monteiro 1996; Aanestad 2002) of IS and the concept of mindful innovation with technology (Swanson & Ramiller, 2004) to explore the challenges of scaling large scale HIS in complex and heterogeneous environments. The cultivation approach entails to be in harmony with the socio-technical systems and to build on the already available resources there, although in a progressive bottom-up approach. Mindfulness on the other hand, is a concept characterised by openness to novelty, alertness to distinction, sensitivity to different contexts, implicit or explicit awareness of multiple perspectives, and orientation in the present (Weick et al. 1999).

The paper uses empirical examples on the challenges of scaling computerised HIS in one region from each of Ethiopia (Amhara) and Nigeria (Jigawa). The two countries

represent the two most populous states in Africa, and together they represent almost 30% of the sub-Saharan population. Scaling of HIS in these contexts is about scaling large scale systems so as to achieve appropriate coverage of the population to make meaningful sense of the data reported to national levels. Using empirical examples from the Health Information System Program (HISP) which is ongoing both in Ethiopia and Nigeria, the paper identified the interdependencies between three spheres as being important in scaling health information systems in the context of low income countries. The three spheres that are explored are the volume of data collected, human resource related issues, and access to technology.

The findings of the paper indicated that, mindfulness enhances the cultivation approach for scaling HIS by suggesting a number of specific characteristics that should be incorporated in dealing with the challenges of scaling of HIS. The paper also suggested that for successful scaling of HIS, mindfulness is required to balance the available human resources, access to technology and the type and volume of data collected by the HIS. By paying attention to the three spheres and their interdependencies, rational choices can be made regarding which aspects of the HIS can be un-problematically scaled and which require specific attention and local adaptation. As such, the paper suggests that a balance needs to be achieved between the three spheres if scaling initiatives are to succeed, and identify a number of factors that can be used to achieve and maintain the balance. This can be achieved through a process of cultivation. Drawing on the empirical analysis of the two cases, and similar accounts in the literature (Braa et al 2007b; Braa et al. 2004; Rolland & Monteiro 2002), the paper identified three strategies (which are labelled as “flexible standards”) as being central to successful scaling of HIS initiatives.

The first flexible standard strategy is the notion of the essential data sets (ESD) “ a set of the most important data elements selected from primary health programs, that should be reported by health service providers on routine basis” (Shaw 2005 pp.632). This strategy gives flexibility to local users to expand the essential data sets to address their specific needs, while still reporting on the essential data required at higher levels. In practice, this means that each region or district will have autonomy to add its own data elements to the

data set as long as it includes the data elements required by the higher level (such as the national level).

The second strategy is in the technical sphere, and related with a scalable process of information collection and collation consisting of gateways between paper based systems and computerised systems which can be interfaced with one another at various levels of the hierarchy as access to technology changes, and which can accommodate heterogeneous (uneven) development across different nodes and implementation sites.

The third strategy proposed by this paper represents the cultivation process- which includes improvisations and a variety of ways to develop, facilitate and motivate increased information use, local champions, commitment and ownership. More specifically, the paper argues that, in order to minimize the risk of failure, a cultivation approach mainly characterized by mindful innovation is required. As such, careful attention to the context is required to enhance the ability to accommodate and absorb change (sensitivity to operations). Plans and implementation processes, therefore, need to be constantly assessed and adjusted according to emerging requirements. In our cases, cultivation has entailed the synergetic interaction between the three spheres. Improved quality of data and information, such as reports that address managers' (and other users) needs, are both caused by and causing improved human resources, which again lead to an improved system including the technical aspects.

In this process, while the users are learning how the system can serve their needs and thereby sparking gradually more advanced requests, those involved in the systems development are learning how to meet these requests. Through this iterative process, the software and overall system are being gradually improved. IS development occurred through small changes and problems are overcome through adjustments of the "ideal" plan to one which is dictated by practicalities (the factors that affect the spheres). Another important learning experience manifested in this paper is how the three authors of this paper collaborate to share their experiences. The three authors represent distinct sub-worlds of the HISP social world. For example the first author has a public health

background and has been working on the implementation and capacity building activities of HISP in South Africa and Nigeria for long time. The second author has an informatics background and has been involved in implementation and capacity building activities of HISP-Ethiopia. The third author, on the other hand is the founder of HISP and a faculty at the informatics department of University of Oslo who had plenty of experiences in coordinating the HISP activities in many different countries in the South. While writing the paper, the three authors interact and negotiate on context-sensitive challenges and tensions they encountered while implementing computerized HIS in different contexts and share their experiences on the approaches and strategies adopted to address the challenges. The paper was an outcome of such mutual learning and interaction of different actors representing different sub-worlds. Moreover, the paper also serves as a boundary object to facilitate interaction with the larger IS community on how issues related to human resource, access to infrastructure, and volume of data influences scaling of HIS across different contexts.

4.1.3 Paper three: “Redesigning Health Information Systems in Developing Countries: the need for local flexibility and distributed control”

By taking empirical data from two case studies conducted in Ethiopia and Tanzania; this paper mainly focuses in identifying the linkage between flexible HIS and decentralized health care management in the context of developing countries. More specifically, it aimed to emphasise on the needs of local levels, as one essential component to address the problem of centralized control in managing HIS activities. The empirical data was collected both from Ethiopia and Tanzania through semi-structured interviews (with health workers at all levels of the health care system, program managers, health information coordinators), document analysis, observation, and discussion with health workers and managers during workshops and training seminars.

Despite widespread efforts and initiatives to strengthen HIS as a crucial tool for decentralised health care delivery in developing countries; there is a strong tendency in most developing countries that HIS reform initiatives continues to reflect the interest and

requirements of the central (national) level without giving any space for local adaptation and change to accommodate local needs and requirements. Traditionally, HIS reform and design initiatives are conducted centrally with no or little end user involvement which results in a centralised HIS with an extensive, somewhat inappropriate, but also inflexible set of standards imposed to be used by the lower levels (such as regions, districts, or health facilities). Consequently, the HIS will not be effective to support the management of decentralised health care services since it cannot produce appropriate information required by local health care managers and practitioners. As such, this paper argues that there is an urgent need to redesign the existing centrally designed HIS in order to make it decentralised and make it appropriate to support local analysis and use of information at lower levels of the health care hierarchy. Based on a comparative case analysis of the structure and functioning of HIS in Ethiopia and Tanzania; the findings of this paper revealed that, the existing HIS in both countries is highly centralized and lacks local flexibility and autonomy in changing reporting formats and data items that are set by the central ministry of health or by vertical health programs. Rigid standards as well as the centralized and inflexible nature of HIS are the main reasons for lack of flexible and well-functioning HIS that supports decentralized management of the public health care system.

Based on the findings, the paper also proposed practical strategies to achieve the redesign of HIS in developing countries. Primarily, this study shows that a well-functioning HIS requires decentralization of authority over HIS and development of local capacity to adapt it to local needs. In order to achieve the goal of developing locally relevant, useful, and well functioning HIS (either paper based or computerised); it is necessary that appropriate authority, capacity and decentralized allocation and management of resources for HIS should be institutionalized at district and sub-district levels. In this way, end users at different administrative levels will get the required skills and knowledge to collect and use information for action and decision making at a local level. Besides, they would be empowered to change the tools and routines to cater for local information system needs without affecting the standards set and required by other levels and systems.

The paper also revealed that the primary goal of redesigning HIS should be to strike a balance between distributed control and local flexibility (autonomy). The central level's need for uniformity and standardised reports, data sets, and indicators at all levels of the health care system needs to be balanced against the local level's needs for flexibility and local autonomy. We claim that decentralization and flexibility should be an equally important design goals for any HIS reform initiative in developing countries. To this end, the paper argues; users' at all administrative levels need to be able to make decisions in order to have tools and routines that are appropriate for local information needs. Besides, there should also be a system to allow end users at different levels to modify and incorporate changes on existing standards and formats of HIS so that to include data on emerging diseases, new treatments, and other services required at a local level.

This paper reveals how tensions between centralized control of decision making power and lack of flexibility to modify things locally are affecting the process of introducing decentralized health care management system across developing countries. As it is presented in empirical findings of the two case studies, due to lack of communication, interaction and negotiation between managers at central level and health workers at a local level; the type of change proposed by international organizations (such as WHO) and national policy makers can't be practically implemented. The findings of this paper, therefore, revealed the importance of addressing tensions and conflicts through negotiation and mutual learning of stakeholders who have conflicting views, interests and values.

4.1.4 Paper four: “Analysing the Challenges of IS implementation in public health institutions of a developing country: the need for flexible strategies.”

This paper explores the challenges of introducing computer-based health information systems in the context of the Ethiopian public health care system. Drawing empirical

examples from the process of introducing computer-based health information systems (HIS) in two regional states (Amhara and Benishangul-Gumuz) of Ethiopia, the paper analyses the challenges influencing the transition towards the new system and suggests the importance of developing context-sensitive strategies to tackle different challenges in different contexts. The study has been carried out as part of the global Health Information System program (HISP), which is a global research and development initiative working on the design, development and implementation of computerized HIS in various developing countries including Ethiopia (see Braa & Hedberg 2002; Braa et al. 2004; Braa et al. 2007a).

The process of developing and implementing IS in the context of developing countries is a challenging task (Heeks 2002; Avgerou 2002, 2007). This challenge mainly emanates from existing adverse situation of the installed base that is characterised by uneven infrastructural development across regions, inadequate skilled manpower, lack of integration and fragmentation of existing standards, tools, and work practices, and varying political commitment and organizational support at national, regional and district levels. The installed base and the impediments associated with it demand different strategies to be adopted and implemented for different contexts and settings. The strategies and approaches adopted are also influenced by a wide variety of factors including: maturity of the new system to be implemented in the new setting, availability of required skills and knowledge to handle the system, project size and complexity, availability of resources and the required infrastructure, and unanticipated events that occur after the initiation of the project.

This paper argued on the importance of developing context-sensitive strategies by taking into account diversity and contextual differences in the process of implementing computer-based HIS in different settings of developing countries. Due to uncertain and unpredictable nature of the public health arena and the uneven infrastructural development, poor human resource capacity, and fragmentation of existing systems; it seems to be little value to come up with comprehensive strategies that could be used as universal solutions in all settings and contexts. In line with this, Bhandari et al. (2004)

noted that because of the complexities and variations in context, it is not possible to develop generic strategies and deploy them in different contexts and settings. Strategies should rather be emergent and targeted in tackling impediments posed by contextual factors.

As such, this paper goes one step further and argues the importance of adapting ‘flexible strategies’ to deal with context-sensitive challenges of adapting and implementing computerized IS in the context of developing countries. The uncertain and unpredictable situation encountered in different settings needs to be tackled through flexible strategies that are tailored to comply with specific challenges and opportunities at that specific time and place. As opposed to the cultivation approach which focuses on continuity and gradual change, the flexible approach focuses on the ability to adapt, in a reversible manner, to an existing situation (Bucki & Pesqueux 2000 pp. 2). In the context of this study, four flexible strategies are identified as being essential in the process of adapting and implementing computer-based HIS in two regional states of Ethiopia. These strategies are: the strategy of gateways, mixing bottom-up and top-down approaches, the use of flexible standards, and the clustering approach.

In summary, one important lesson that come out of this study is that, lack of resources (infrastructural, financial and skilled manpower), as well as uncertain and unpredictable environments constrain the process of introducing ICT based systems and tools in the context of developing countries. The empirical analysis of this study showed how it is difficult to employ strategies developed in one setting to address challenges encountered in another setting before they are appropriated and adapted to fit to the new context. Lessons learned and strategies developed in one setting could only be used as points of departure to develop new strategies by taking into account infrastructural, human resource, existing systems, and work practices and tools in the new setting. Strategies developed for one setting can’t also be used for good to deal with all the problems in that setting. They should rather be regularly negotiated and reformulated based on emergent trends and problems, new interests, new policies, new actors, and uncertainties from the external environment. Such strategies should only be developed and maintained through

continuous learning, negotiation, and by being sensitive to changes and uncertainties in the environment. That is why, this paper emphasized the importance of developing flexible strategies to deal with context-sensitive challenges in the process of implementing computer-based IS in developing countries which are often characterized by uneven development across regions in the same country and between zones and districts within the same region. The strategies that are developed in this paper are results of the practice-based and situated learning of the researcher and the public health domain experts at a local level through their interaction and negotiation to address the tensions and challenges influencing the transition from existing paper-based system to computerized HIS.

4.1.5 Paper five: “Understanding the Dynamics of Learning across Social Worlds: A Case Study from introducing IS into the Ethiopian public health care system.”

This paper advocates a learning perspective on information systems development and implementation. Drawing on empirical material from global Health Information Systems Program (HISP) initiatives on development, customization and implementation of two different versions of District-based Health information Software (DHIS) in the context of the Ethiopian public health care system, the paper demonstrated how the development and implementation of HIS can become an arena for interaction, negotiation, and mutual learning between different stakeholders from multiple social worlds and sub-worlds, mainly from the public health and IS domains.

The paper employed a qualitative research approach, based in the interpretive tradition (Walsham 1993), which seeks to understand complex social, technological and organizational issues related to the development, customization and implementation of information systems in different contexts.

Conceptually, the paper adopted the ‘third way’ (Elkjaer 2004; Huysman & Elkjaer 2006) of organizational learning as its theoretical lens. The ‘third way introduces the notion of social worlds that opens up an understanding of organizations as social worlds held

together by commitment to organizational situations and events (Elkjaer 2004). Besides, the social world perspective provides the image of organizations as arenas of negotiated orders and learning as a process of actions, interactions, and negotiations triggered by tensions and conflicts emanating from differences in interest, practices and values among different actors from participating social worlds and sub-worlds.

The paper describe and analyse the tensions, conflicts and negotiations between IS developers and public health care domain experts, the evolution of technological capacity at individual, group, and organizational levels, and the organizational commitment and buy-in in the process of developing, customizing, and implementing the two distinct versions of DHIS software. We have also included a discussion on the benefits of the social worlds perspective, and sketch its practical and theoretical contributions for the IS field.

4.2 Synthesis of Findings and their Inter-linkage

This section analyses the empirical findings of the papers presented in the previous section and how they are inter-linked with regard to answering the research questions posed in this thesis. As it is presented in the first chapter, this thesis aimed to answer the following research questions:

- What are the tensions and conflicts that trigger mutual and interactive learning between stakeholders from distinct social worlds and sub-worlds in the process of adapting and implementing computerized HIS in the context of a developing country?
- How does local and situated learning of different stakeholders help to understand and address the challenges of cultivating the installed base of existing HIS as well as scaling and sustaining local interventions over time?

The empirical findings of this thesis revealed that, the process of designing, developing and implementing computerised HIS in public health care settings of low income countries is an arena for learning within and between different social worlds (sub-

worlds). In this thesis, I argue that learning is mainly triggered by tensions and conflicts of different stakeholders who have different interests, commitments and values. The tensions and conflicts are managed through on-going actions, interactions and negotiations of the involved actors participating in standardising data sets as well as customization and implementation of the technology at different levels. This section, therefore, primarily aims to identify and summarize the tensions and conflicts encountered in introducing change to existing routine paper-based HIS in the context of the Ethiopian public health care system and how those tensions and conflicts trigger learning between different actors within and between multiple social worlds (sub-worlds).

The second research question aims in exploring the implication of the situated and local learning in dealing with the challenges of cultivating installed bases of existing systems, technologies, standards and work practices; scaling local initiatives, and sustaining them at a local level over time. The discussion about this research question is presented under the contributions and implications chapter (section 5.1.2). In this section, therefore, I provide a synthesis of the findings with regard to tensions and conflicts within and between different social worlds and how those tensions trigger learning among different actors.

4.2.1 Tensions and conflicts within and between social worlds (sub-worlds) as drivers for learning

As it is described in the theoretical chapter of this thesis, the social worlds perspective (the ‘third way’) is an alternative perspective to theorize learning and mainly focuses in understanding tensions and conflicts that emanate as a result of different commitments of stakeholders to organizational activities, practices and values. As such, the social worlds perspective provides a lens to understand learning as a result of tensions and conflicts between different social worlds (Elkjaer & Huysman 2008). This section, therefore,

draws empirical examples from the findings of the different papers included in the thesis, and explores the tensions and conflicts between different actors from distinct social worlds (sub-worlds) and how mutual and interactive learning unfolded among those actors. More specifically, I identified four major sources of tensions and conflicts that trigger learning among different stakeholders in HIS development and implementation. These are: inadequate knowledge, competency and different knowledge traditions; centralized control and lack of local flexibility (rigidity of existing HIS structure) to accommodate local needs; multiple institutional practices of the public health care system; and the need to balance context-specific needs with global requirements. Each of these issues are described in the following sub-sections.

4.2.1.1 Inadequate knowledge, competency and different knowledge traditions

Inadequate and limited local skills and knowledge base in a wide range of areas contributes to failure and unsustainable IS in developing countries (Heeks 2002). Similarly, this study reveals that inadequate knowledge and poor competency on IS development tools and technologies (including programming languages, database systems, systems analysis and design and tools) as well as public health knowledge (including awareness on epidemiology, standards of different vertical programs, routine health data collection and analysis, indicator based data analysis etc.) is a major problem that threatens the long term viability of new systems and standards to be introduced in public health care settings of the developing countries. This lack of skills and knowledge creates tensions among actors within and between different social worlds participating in HIS design, customization and implementation.

For example, the findings of this thesis revealed that poor technical competency on Java frameworks and other open source technologies by local HISP-Ethiopia development team members created a tension at the initial stages of customizing DHIS 2.0 to the Ethiopian context (paper V). More specifically, the need to develop and incorporate a new module called Morbidity-Mortality module (a module required for the Ethiopian public health care system context) to DHIS core was a challenging task for two reasons. Primarily, system developers were posed with the challenge of understanding how

morbidity and mortality data is collected analysed and reported using the complex ICD (International Classification of Diseases) code. Secondly, developing the new module from scratch not only requires deep technical knowledge on Java frameworks, but also demands the need to formulate strategies on how to link the new module when new versions are released by the global development team. This created tension and become a source of discussion, interaction and negotiation within the HISP-Ethiopia development team as well as among developers in the wider world of the global HISP development team.

Similarly, lack of skill and knowledge on computer systems and applications sparked tension between health domain experts (health workers, statisticians, managers at different levels) and the use of the technology (DHIS) while it was implemented in different public health care institutions of AAHB, Amhara and Benishangul-Gumuz (papers I,II, IV, V). As Titlestad et al (2009) noted, in the context of developing countries, due to lack of technical competency on computerised information systems, potential users in the health care sector often have no or extremely limited exposure to technologies and computer systems. This creates a tension on the usability of the system and demands the need to formulate capacity building strategies using interactive prototypes at a local level before the system is implemented. The findings of this thesis revealed that, in spite of such capacity building initiatives provided in different settings, users sometimes fail to grasp the trainings given to them. For example, in Amhara regional state, in spite of the first round of training given to 11 zonal HIS officers on the functionalities of DHIS technology, most of the trainees failed to absorb the first round of training and were unable to use the system. This created a tension and demanded a second round of on-site training support to be offered to each respective zonal HIS officer by the regional HISP-Ethiopia team members (see paper II, IV).

Another knowledge related source of tension and conflict between the different actors involved in HIS design, development and implementation is the different knowledge tradition, background, practices, methods and representation of concepts between IS and public health domain experts. As Pagliari (2007) indicated, traditionally many eHealth

software development projects are conducted in the context of short contractual agreements, where neither developers nor health care domain experts have the time, interest and opportunity to be engaged in cross-disciplinary learning. As a result, software developers and the health domain experts work in parallel universes, each regarding the other's domain of activity as distinct and neglect the potential for useful interaction and learning (ibid). In recent days, however, there is a growing emphasis on interdisciplinary collaboration and learning in the design and development of IT based systems and tools in multi-disciplinary projects including computing and health sciences (see for example, Pagliari 2007; Valentin 2008; Olsen 2009). This, however, requires the need to establish meaningful dialogue between stakeholders from the IS and public health domains and to appreciate each others' terminologies, goals, and methods and to share each others' experiences, skills and knowledge through on-going interaction and collaboration.

The process of developing and implementing computerised HIS is an arena where people from different disciplines (from IS and public health) or functional departments (within each domain) come together and collaborate while standardizing data collection and reporting tools and adapting and appropriating software to meet local needs. However, due to the difference in knowledge traditions, culture, and practices the stakeholders both from the IS and public health domains often pursue their own methods and traditions, push forward their own ways of doing things, and fight for their own goals and expectations. Balancing the interests, demands and requirements of these disciplinary and functionally diverse groups with diverse knowledge traditions creates tension among the groups involved in the process of designing and developing the system.

The findings of this research also revealed such tensions which are basically emanated from differences in disciplinary background and knowledge traditions. This type of tension was manifested, for example, in the process of customizing DHIS software which is mainly targeted to meet the requirements of health workers, managers, and statisticians at different levels of the public health care system. The customization process was a collaborative activity where the IS experts heavily rely on the support of public health experts to get specific information on the data elements required, types of reports, their

frequency and the report layout. However, due to their different knowledge traditions, the IS experts often focus on the technical aspect of systems development, whereas the public health experts give much more emphasis on their data sets and how the reports should look like without giving any attention to the technical requirements.

The situation had, however, improved as different stakeholders from both disciplines start to learn from each other as a result of intensive interactions and negotiations. For example, the IS developers understand the importance of incorporating the users' demands (for example designing the reports as they appear on the existing paper form), understand the specifics of public health data collection, analysis and reporting tools, the need of different vertical health programs and services, and the routine tasks of health workers at facility levels to mention a few. The public health experts, in their part learn the importance of the application of computers and the DHIS software to facilitate their routine tasks (papers IV and V). An incremental and participatory implementation of the software as well as standards, indicators and reporting formats helps to deal with the tensions through mutual and interactive learning. A good example of this type of learning is the process of customizing and implementing DHIS 1.3 in public health care institutions of the AAHB (paper V) where the different stakeholders (both from the IS and public health) interact and negotiate on data sets, indicators, reporting formats, functionalities of the software and come up with a standardised set of data elements and indicators, and customized and implemented the software as per the new requirements.

4.2.1.2 Centralized control and lack of local flexibility

Centralized control and lack of flexibility is a tension related to the rigidity of the existing system, structure and work practices (i.e. the installed base of existing HIS) in data collection, analysis and reporting. The installed base (which is characterised in terms of existing standards, technologies, systems, tools, work practices and routines) displays an inherent challenge in re-designing and developing an integrated computerised HIS as well as in scaling the system to different health care institutions and making it sustainable at a local level over time. The inflexible and rigid nature of the installed base sparks tension when an attempt is made to modify or improve existing standards, tools,

technologies, systems, work practices and routines. For example, this study revealed that in the context of the Ethiopian public health care system, data collection and reporting standards set by the Federal Ministry of Health (FMOH) and vertical health programs are extremely rigid and do not allow any change or modification to be undertaken at a lower level. This creates tensions between local needs and the requirements of vertical programs as well as national standards. If we take the case of introducing new standards, systems and work practices across different levels of the public health care system; there is always a tension to balance the interests of local actors and the requirements of global (national or international) actors. More specifically, while addressing the challenges of developing data collection and reporting tools and standards, there are multiple voices and interests that reflect the needs and requirements of both local and global actors. The local actors (including health workers and managers at facility or district levels) demand for local empowerment and local flexibility in formatting data collection tools, adding new data elements, or for integration of reports to avoid duplication of work. The global actors (including vertical program managers and national ministry of health) each struggle to impart their own interests. The federal ministry of health promotes the federal frameworks of data standards and reporting requirements where as the vertical programs wanted to include their own data sets in the integrated standardized system. Addressing these conflicting interests requires an on-going interaction, negotiation and collaboration of multiple actors from national, regional, and district levels. It is through this interaction and negotiation process that change is enacted and the actors involved in the process learn from their engagement in the change process (see Papers II, III, IV, V).

The findings of this thesis also revealed the need for HIS to be re-designed in a way that allows a balance between centralized control and local flexibility in modifying and appropriating existing standards according to local needs. This can be achieved by introducing the principle of essential data sets (EDS)⁹, introducing scalable process of information collection & collation consisting of gateways between paper-based and computer-based systems, and applying the cultivation approach to introduce change both

⁹ EDS are “a set of the most important data elements, selected from primary health care programs, that should be reported by health service providers on a routine basis” (Shaw, 2005, pp. 632).

at local and global levels. The EDS approach allows a hierarchy of information needs, where the local users can expand the essential dataset to address their specific needs, while still reporting on the essential data required at the central level (see Braa & Hedberg 2002; Braa et al 2007a). In this way, data collection tools and reporting formats and essential data sets were standardized re-designed in different regional states (including Addis Ababa and Amhara) through interactions, negotiations, and mutual learning of different stakeholders. This gives health care managers, statisticians, and health workers at a local facility or district level the flexibility to modify and change data collection tools as per their local information needs without affecting the standards set by the higher level (i.e. vertical programs and national ministry of health).

Local flexibility is also essential in customizing DHIS software and in integrating the flow of information between incompatible technologies and systems. Integrating new systems or technologies to existing systems or technologies always creates a tension and requires a careful assessment of existing systems and technologies. Gateways are used to connect heterogeneous systems and technologies developed independently or based on different versions of the same standard and make them interoperable. The change from existing systems into the new one could be conducted by introducing different transition strategies including a variety of gateways (such as paper-to-paper, paper-to-computer, and computer-to-computer). Utilizing different gateways as per local requirements accommodates local flexibility and enables the replacement and interconnection of previously incompatible systems or sub-systems (different versions of DHIS and other data management tools such as EpiInfo) without affecting the flow of information through the whole system (paper II, IV). This process brings a learning experience for different actors both from the IS and public health domains as a result of their interaction, and negotiation to formulate context-sensitive and flexible strategies based on their learning about the local context.

4.2.1.3 Multiple institutional practices of the public health care system

The multiple institutional practices of vertical programs in conducting their data collection, analysis and reporting is always a source of conflict and tension between vertical program managers and other organizational actors striving to integrate and standardise existing data collection and reporting tools. The vertical program managers often want to maintain their own power in how they collect, and report routine data related to their specific programs. There are three main reasons why vertical program managers are against an integrated HIS. Primarily, there is an assumption that integrating the data collection and reporting system to be managed centrally through planning and programming offices would result in elimination of some of the data items required by vertical programs. Secondly, most vertical programs seldom trust the capacity of the regional as well as national planning and programming department to provide an integrated data management service effectively. Thirdly, there is a pressing demand from donor agencies to undertake data collection and analysis independently for the specific program they support.

On the other side, there are actors (such as national and regional planning and programming departments) who argue on the importance of developing an integrated health management information system (HMIS) by standardizing the existing fragmented data collection and reporting tools and developing essential data sets and indicators to be used at different levels of the public health care system. These groups of actors argue that developing an integrated HIS enhances efficiency and control by “implementing a seamless, consistent, coherent, non-redundant and uniform reporting system” (Chilundo 2004, pp. 91). Changing existing multiple institutional practices of vertical health programs, however, is a source of tension and conflict between actors from vertical programs and those who pursue the integration agenda.

In the context of this study, this tension was witnessed by the researcher in the process of standardising existing data sets, indicators and reporting formats in Addis Ababa, Amhara, and Benishangul-Gumuz regional states (see papers I, IV, V). The existence of

multiple institutional practices creates tension and additional workload on people at lower levels who undertake the data compilation and reporting to different vertical programs and services. The empirical examples of this study revealed that these multiple institutional practices of the public health care system could only be changed through negotiated order. Stakeholders with different interests and voices come together and negotiate on the problem of existing standards, work practices of different vertical programs, tools and the way data is collected, analysed and reported. It is through such on-going discussions and negotiations that people learn on the weaknesses of the existing work practices and systems and show their commitment and support to introduce a system that balances the interests of all involved stakeholders. For example, during the process of standardizing data sets and reporting formats for public health institutions of the Addis Ababa health bureau; at early phases of the standardization process, there was strong resistance from different vertical program managers on the idea of developing an integrated HMIS that brings all the essential data sets of different health programs together. However, through on-going negotiation and interaction between the actors from vertical health programs, regional health bureau management and the IS team, it was possible to develop a standardized data set and reporting format that allows different health programs to collect and report routine data using uniform data collection and reporting tools (see paper V).

4.2.1.4 Balancing context-dependent needs with global requirements

In HIS design, development and implementation balancing context-dependent needs and interests at a local level with universal requirements and standards is a source of tension and should be addressed through interactions and negotiations of stakeholders from different social worlds. This tension has been manifested at different levels and magnitude during the process of adapting and implementing DHIS software across different regional states in Ethiopia. With regard to this local-global dichotomy, the prominent issue that I would like to emphasise as a source of tension is the interaction between local and global developers and researchers within the HISP network. More specifically, I will emphasise on how the global agenda of HISP to develop open source software to be used across developing countries as well as its overall philosophy of

designing and developing district-based health information system across different countries including Ethiopia are balanced with the reality on the ground in different contexts and settings at a local level (in terms of availability of skills and knowledge to do software customization, availability of technologies and infrastructure, and the potential of building local capacity through global partnership). Balancing context-sensitive demands with global requirements is a source of tension that needs to be dealt through the interaction, communication, negotiation and mutual learning of local and global actors.

HISP has developed different versions of DHIS software (the earlier versions i.e. DHIS 1.3 and 1.4 by developers from South Africa and the recent version i.e. DHIS 2.0 mainly by developers from Oslo); and are customized and implemented in different countries to meet local needs of different countries in the South. HISP promotes collaboration, co-development and sharing of experiences and best practices among developers working in different countries (Braa et al. 2007b). However, the differences, in background, skill and knowledge of the development tools and technologies among different developers working on the customization of DHIS software for their own specific local requirements creates tension to undertake meaningful collaboration between the local and global developers. There is also a tension to strike a balance between adapting the core module to local contexts, developing new modules specifically required at a local level (such as morbidity and mortality module developed in the Ethiopian context) (Paper IV & V) and coping to global standards of the core modules developed by global developers (Braa et al., 2007b).

In the Ethiopian context, the development, customization and integration of reports and modules required locally (such as the ICD module) with the core DHIS 2.0 database was initially influenced by lack of skill and knowledge on Java programming and other core technologies used to develop the system. The inadequacy of knowledge on development tools created tension among local developers and significantly influenced the development of locally required modules and the customization of import-export as well as report modules. At latter stages, however, these tensions were managed by building

the capacity of local developers through in-house training on some core technologies (such as Java) and hands-on exercise in collaboration with developers from global partners mainly from Oslo and Vietnam. At latter stages, HISP also hire an experienced local developer who significantly contributed in strengthening the technical competency and skill of local development team and assisted in finalizing the ICD module and customization of other required modules. Through this process, both local and global developers learn from their engagement and participation the development process and through in-house training, and learning by doing (see papers IV & V).

4. 2. 2 Summary of Findings in terms of the research questions posed

Research Question	Article	Key Findings
<p>What are the tensions and conflicts that trigger mutual learning between actors from distinct social worlds and sub-worlds in the process of adapting and implementing computerized HIS in the context of low income countries?</p>	<p>II, IV, & V</p> <p>II, III, IV</p> <p>I, IV, V</p> <p>II, IV, V</p>	<p><i>Inadequate knowledge, competency and different knowledge traditions</i></p> <ul style="list-style-type: none"> • Poor technical knowledge of IS developers and implementers on development technologies and tools • Inadequate human resource in the public health sector with basic computer skills and knowledge • Different knowledge traditions, background, practices, and methods between IS and public health domains <p><i>Centralized control and lack of flexibility</i></p> <ul style="list-style-type: none"> • Integrating new systems and technologies through gateways and transition strategies • Rigidity of existing standards • The need to redesign organizational routines and work practices <p><i>Multiple Institutional practices of the public health system</i></p> <ul style="list-style-type: none"> • Multiple data collection and reporting tools of vertical programs • Unstandardized data collection and reporting tools • Multiplicity of work practices <p><i>Balancing context-sensitive needs with global requirements</i></p> <ul style="list-style-type: none"> • Balancing global requirements with local contexts by taking into account local competency and access to technology • Interaction between local and global developers
<p>How does the mutual learning of stakeholders would help to understand and address the challenges of cultivating existing HIS as well as scaling and sustaining local interventions over time?</p>	<p>I, II, IV, V</p>	<ul style="list-style-type: none"> • Learning enhances the ability of individual and collective actors to give careful attention to differences in context and the importance of developing flexible approaches and strategies to deal with context-sensitive challenges. • Learning creates conducive environment for inter-disciplinary collaboration and partnership to deal with the challenges of IB cultivation. scaling and sustainability • Learning helps to build local competency on technology as well as on data analysis and compilation and contribute for scaling the system to new settings and ensure the long term viability of the system at a local level.

CHAPTER FIVE

Research Contributions and Concluding Remarks

This chapter provides a summary of the theoretical and practical contributions of the thesis. As such, section (5.1) presents the theoretical contributions; whereas section 5.2 describes the practical contributions mainly in the context of IS development and implementation in low income countries. Section 5.3 presents limitations of this study and the final section (5.4) provides concluding remarks.

5.1 Theoretical Contributions

In this thesis, I have followed the interpretive tradition and considered the development and implementation of IS to be a dynamic process that is likely to develop through the actions, interactions, and conflicts of multiple actors and will always be subject to multiplicity of meanings and interpretations depending upon the theoretical position adopted by the researcher. My theoretical position is to conceptualize organizations as arenas made up of social worlds held together by commitments to organizational practices, tasks, and values; and learning as a dynamic process that emerges from the tensions and conflicts created by the social worlds' different commitments to organizational practices, activities, and values (Strauss 1978; Clarke 1991; Elkjaer 2004, 2005; Elkjaer & Huysman 2008).

The theoretical contribution of this thesis is, therefore, threefold. Primarily, it introduced a novel lens for looking the development and implementation of IS in general and HIS in particular in the context of developing countries. Secondly, it developed a conceptual framework that helps to understand the links between learning and the challenges of scaling, sustainability, and installed base cultivation in the context of IS research in developing countries. Finally, implications of the findings of this research for IS in the

context of developing countries is provided. Each of these contributions are discussed in subsequent sub-sections.

5.1.1 HIS development and implementation as Learning across social worlds

This thesis emphasised that the process of developing and implementing technical artifacts, standards or introducing change to work practices in public health settings of developing countries is a dynamic process of mutual and interactive learning. As such, the process of introducing change to exiting paper-based routine health management information systems by introducing computer-based systems, standardizing data sets and work practices is conceptualized as a negotiated order whereby diverse stakeholders from multiple social worlds and sub-worlds interact and negotiate to address different tensions, conflicting views and differences in interest and values. It is through this negotiation and learning process that tensions, conflicting interests, changing needs, and multiple voices of different actors are negotiated and mediated.

By conceptualizing HIS development and implementation as learning across multiple social words and sub-worlds; this thesis aims at contributing to deeper theoretical understanding of the learning perspective in IS development and implementation in the context of developing countries. Recent discourse in IS literature emphasised the importance of the learning perspective (see for example Cibora & Lanzra 1994; Lyytinen & Robey 1999; Robey et al. 2000; Westell 1993, 1999; Zong & Majchrzak 2004; Mathiassen & Pedersen 2005, Small and Sice 2008) to better understand the process of developing, implementing and using information systems and technologies in different settings and organizational contexts. However, in the context of IS in developing countries, the learning perspective is not explored comprehensively though some scholars argued on the importance of learning based approaches to understand the process of IS design, development and implementation (see Braa et al. 1995; Braa 1997; Braa et al. 2007b).

This thesis, therefore, adopts the social worlds perspective (Strauss 1978; Elkjaer 2004; Huysman & Elkjaer 2006) of learning as its overarching theoretical lens to explore the tensions and conflicts that trigger learning in the process of developing and implementing computerised IS in public health care settings of developing countries. The social worlds perspective is a more pragmatic understanding of learning which assumes that learning emerges from the tensions and conflicts created by the social worlds' different commitments, interests and values to organizational practices. By bringing the social worlds perspective to IS design, development and implementation in the context of developing countries and by providing empirical ground to the tensions and conflicts that trigger learning among actors across different social worlds, this thesis contributes to deeper understanding of IS development and implementation in third world contexts. HIS development and implementation, I argue, is a learning process where tensions, conflicting interests, and changing needs are mediated through the actions, interactions and negotiations of different actors from multiple social worlds (sub-worlds). As such, this research extends not only our understanding of how learning takes place across a local web of actors and practices (within the social worlds of the public health and IS domains), but also with in large and globalized network of actors and practices (within the social world of the global HISP).

The thesis also makes a theoretical contribution by conceptualizing HIS development and implementation as “negotiated order” (see Strauss 1978; Fine 1984; Rahaman & Lawrence 2001; Modell 2006). By drawing empirical examples from the design, development and implementation of computerised HIS in the context of the Ethiopian public health care system, the thesis argues that developing and implementing computerized HIS in developing countries is the result of interaction, communication, and negotiation of multiple stakeholders from different social worlds (mainly from the IS and public health domain) with varying and conflicting interests and goals. The new standardized data sets and reporting tools, or software implemented in different public health care institutions are results of the negotiated order where different actors learn and develop common understandings that extend, dismiss, reinforce or confirm existing attitudes, interests, values, and practices. This negotiated order is an on-going learning

process whereby different stakeholders from different social worlds interact and negotiate using a variety of boundary objects to address the tensions and conflicts through their situated actions, interactions and negotiations in the process of developing integrated and standardized data collection and reporting tools, customizing and implementing software, build local competency and skills, and introducing new work practices and routines.

This thesis also shade light on the relationship between boundary objects and the notions of negotiated order and social worlds. In this thesis, boundary objects are treated as tools that facilitate and mediate the interaction and negotiation of stakeholders from different social worlds (sub-worlds). Empirical examples have been provided on how different types of boundary objects (including technical artifacts such as DHIS, standards) have been used by different stakeholders from distinct social worlds (sub-worlds) to mediate tensions, conflicting views, and to negotiate meaning on a number of problems and challenges they encounter including: how to standardise data collection and reporting tools, how to redesign existing paper-based HIS, how to use computers to improve existing work practices, how to improve skill and knowledge deficiencies across different domains, what resources and infrastructure are required to implement the new system across different levels, how existing multiple work practices and standards affect the change process and so forth. The learning, I argue, developed from the process is continuous as new interests, practices and values create continuous tensions and conflicts (Elkjear & Huysman 2008), which in turn needs to be continuously negotiated and re-negotiated. It is in this process of interaction and negotiation that different stakeholders from diverse social worlds and sub-worlds learn from each other on how to deal with problems and challenges, co-develop strategies to tackle them, or break alliances if the involved actors can't compromise their interest and develop mutual learning.

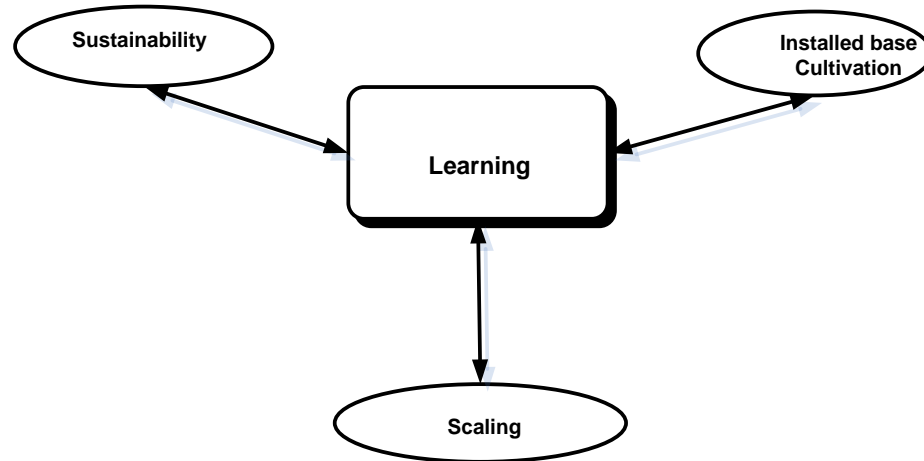
5.1.2 The relation between learning and the notions of installed base cultivation, scaling, and sustainability

This section answers my second research question: how does local and situated learning of different stakeholders help to understand and address the challenges of cultivating the installed base of existing HIS as well as scaling and sustaining local interventions over

time? As it is presented in the previous chapter (Chapter four), the findings of this thesis revealed that HIS design, development and implementation is a dynamic learning process of multiple human and institutional stakeholders within and between multiple social worlds (sub worlds). As such, I argue that the situated learning developed through the practical actions, interactions, negotiations and communications of the actors from different social worlds (sub-worlds) helps to understand as well as address the challenges of scaling, sustainability and cultivating the installed base. Learning does this by enhancing the ability of individual and collective actors to give careful attention to multiple perspectives and contextual differences (Weick 2001), to understand the local context (in terms of infrastructure, skills and knowledge required, political commitment and support), and to be informed on the potentials and impediments influencing the change process. In order to discuss my theoretical contributions and implications with regard to the relationship between learning and the notions of scaling, sustainability and installed base cultivation; I developed a conceptual model (figure 5.1) that conceptualized learning as central to understand and address the challenges of cultivating installed bases; scaling local initiatives, technologies, experiences and best practices both geographically and functionally; and in ensuring the sustainability and long term viability of the intervention at a local level in the long run.

I also argue that, though learning is central and essential to understand the practical and theoretical challenges of scaling, sustainability and IB cultivation; people also learn from the tensions, conflicts, and uncertainties emerged in the process of adapting and cultivating existing installed bases, scaling local initiatives, and from the strategies and approaches introduced to ensure long term viability and sustainability of the initiatives. The theoretical framework suggested in this thesis, therefore, would contribute to IS studies in general and HIS development and implementation in developing countries in particular by developing analytical framework that shows the interplay between learning and installed-base cultivation, learning and scaling as well as learning and sustainability (see figure 5.1). A more detailed description on learning and the aspects of installed base cultivation, scaling and sustainability is provided in the subsequent sections.

Figure 5. 1: *The Interplay between learning the notions of installed base cultivation, scaling & Sustainability*



5.1.2.1 Learning and Installed base cultivation

Various proponents of the information infrastructure perspective (see for example, Hanseth & Monteiro 1998; Hanseth & Aanestad 2003; Ellingsen & Monteiro 2003) have used the cultivation approach to address change to existing installed bases of infrastructure, standards, systems, and technologies in an incremental and gradual manner. The cultivation approach suggests that an installed base is not a dead artifact; rather it involves an existing network of systems, tools, technologies, standards, work practices and users (Hanseth 2002; Hanseth & Aanestad 2003). Modifying or Changing the installed base, therefore, requires the alignment of different commitments, interests and values through the interaction, negotiation and learning of different stakeholders. This interaction and negotiation ranges from a small meeting and discussion with local developers and implementers on software customization to a top level political negotiation to get the support and commitment of top management to introduce computer-based systems and to modify or change existing systems, tools, standards and work practices.

In the context of this thesis, the cultivation approach is applied to denote an on-going and continuous process of adapting, modifying and changing existing installed bases through situated practices and collective action of different stakeholders from multiple social worlds. The existing installed base influences how new systems, technologies, standards, skills & knowledge, and work practices are cultivated and developed.

As such, cultivation helps to understand the social, political, and infrastructural aspects of the existing system and can be used to negotiate which part of HIS is problematic and needs to be changed; and which part to be cultivated and modified through negotiation, communication and learning of different actors involved in the change process. In line with this, Kimaro (2006) argued that cultivation is a strategy that “requires an alignment of various political and technical interests of various actors through negotiations” (ibid, pp.109). It is through dialogue and negotiation of actors from different social worlds that new ideas, tools, standards, and systems are cultivated, customized, improvised, and implemented across different levels of the public health system. The installed base of HIS consists of all existing systems, standards, tools, technologies, infrastructure, manpower and routine work practices. This thesis revealed that it is through negotiation of different stakeholders from multiple social worlds (sub-worlds) that the historically existing and socially and politically constructed installed base of the existing HIS is cultivated and evolves in a gradual and step-by-step fashion based on mutual learning and understandings of involved actors at a local level.

This thesis revealed that, learning is central to the process of installed base cultivation where existing systems, standards, technologies, routines and work practices are modified or changed through the actions, interactions and negotiations of actors from different social worlds. Learning based installed base cultivation not only requires careful assessment of the installed base, but also an incremental and on-going engagement and negotiation between multiple stakeholders at different levels to make a decision on how to change or modify existing systems, standards and work practices, to identify context-sensitive and flexible transition strategies to bridge incompatibilities, to build local capacity and competency, and to deal with infrastructural challenges (papers I, IV & V).

More practically, the findings of the study revealed that the whole process of standardizing data collection and reporting tools, adapting the software to local requirements, and implementing as well as scaling of the new system and standards to public health care institutions of different regional states was a process of cultivating the installed base mainly based on the actions, interactions, and negotiations of different stakeholders both from the IS and public health domains (papers I, II, V, VI). The learning at each specific stage of HIS adaptation process serves as the basis to undertake other tasks. For example, by participating in the process of standardization of routine data collection tools and forms, HISP-Ethiopia development team can get specific knowledge and understanding about HIS, its structures, data items, indicators, reporting formats etc. This knowledge and experience can in turn be used as a point of departure to customize DHIS software for other settings and contexts (paper I, II, IV, V).

However, since the installed base of different regional states in Ethiopia is quite diverse, the cultivation approach adopted in each region as well as the learning and experience acquired by the involved actors varies significantly. For example, in Benishangul-Gumuz regional state, it was identified that the existing ICT and physical infrastructure at zonal and district levels was so poor to support the implementation of computerized HIS in all public health institutions. It was also identified that there is inadequate qualified manpower to handle computerized HIS at different levels of the regional public health care system. Besides, the findings revealed that the existing HIS was designed to support the requirements of national ministry of health and specific vertical programs without local use of information at regional, zonal, district, and health facility levels. This understanding of the facts on the ground that are related to infrastructure, manpower and how existing HIS functions, helped all the actors (both from the regional, zonal, district health care system and the HISP team in the region) formulate specific context-sensitive strategies to tackle the challenges related to access to digital and physical infrastructure, inadequate manpower and fragmented and unstructured HIS (see Paper I & IV). Whereas in Amhara regional state, due to the relatively good access to ICT related infrastructure, the system was implemented in 11 zonal health offices and the regional health bureau. However, the implementation plan had to be reassessed since efforts

undertaken to cultivate the skills and capacity of zonal HIS coordinators with regard to DHIS technology were hindered by their limited ability to absorb the training (see paper II and IV).

5.1.2.2 Learning and Scaling

In the context of IS, the notion of scaling is used to describe the processes and challenges of extending a process or a product both in scope, size and functionality. As such, scaling is not only about extending the scope, size and functionalities of technological artefacts and systems, but also a process of reproducing and translating the necessary learning process across different settings and social worlds.

The experience and knowledge accumulated through practical actions of standardization, software customization, user training, and scaling of the system in a given regional state and its health care institutions (for instance, the experiences in Addis) were used to understand and address the challenges of scaling computerized HIS to other regional states (in this case Benishangul-Gumuz and Amhara regional states). In spite of the differences in context in terms of standards used, existing infrastructure, manpower, work practices in the new setting; learning from previous experiences has been used as an entry point to initiate the customization, standardization, and scaling process. Local and situated learning through the actions, interactions and negotiations of different stakeholders also helps to formulate appropriate scaling strategies based on reality on the ground (i.e. in terms of physical and technological infrastructure, manpower, geographic size). By paying attention to different problems and challenges that influence the scaling process (such as availability of infrastructure, qualified manpower, access to technology, political commitment), rational choices can be made regarding which aspects of IS can be unproblematically scaled and which require specific attention and local adaptation.

For example, although HISP favours the bottom-up strategy to customise and implement DHIS software in many developing countries where HISP is functioning including South Africa (see Braa and Hedberg 2002; Braa et al. 2007); in the Ethiopian context, most of the HISP pilot regions adopted a top-down strategy while others combine both the top-

down and bottom-up scaling and implementation strategies. For example, in Amhara regional state, while scaling HIS along the vertical axis (to increase the depth of penetration by reaching out different zones, districts and health facilities) a top-down strategy was adopted after making a careful assessment of the existing installed base (in terms of manpower, access to technology, and availability of infrastructure). As a result, the system was implemented to the 11 zones, where as the implementation to districts (woredas) was delayed until conditions were favourable for scaling (mainly in terms of availability of physical and ICT infrastructure including computers, electricity, telephone and adequate qualified manpower to handle the system) (see paper II). Where as, in Addis Ababa, due to its smaller geographic size and availability of better infrastructure; a scaling strategy that combines both the bottom-up and top-down approaches were adopted to successfully scale the system to regional health bureau and all the 11 sub cities and 23 health facilities of the region (Paper V). In Benishangul-Gumuz regional state, on the other hand, due to absence of ICT based infrastructure (including computers, telephone, and electricity), as well as lack of adequately trained manpower to handle the HIS at zonal and district levels, the top- down strategy to scaling was adopted and the implementation of the computerised HIS and data capture was initiated at the regional health bureau level (paper I).

Lessons learned in scaling the system in one setting (region, zone or district) could also be used to address scaling challenges in other settings. This has been, for example, the case while DHIS 1.3 was scaled from Addis to other regional health bureaus. The standards and the software customized for Addis was taken as a point of departure to undertake standardization and software customization in other regions including Benishangul-Gumuz, and Amhara. Besides, the practical lessons learned from scaling the system to sub-cities and health facilities in Addis has been used by HISP-Ethiopia team members in Amhara and Benishangul-Gumuz regional states to consider infrastructural as well as human resource aspects before making a decision on scaling the system to lower levels (including districts and health facilities).

5.1.2.3 Learning and sustainability

In IS research, the term sustainability is used to describe the process of making an IS work in practice at local level after external support is terminated (Braa et al. 2004; Kimaro and Nhampossa 2005); or to refer to the process of identifying and managing risks that threaten the usability and long term viability of the IS (Korpella et al. 1998). In this thesis, I argue that, sustainability at a local level is only achieved when the change initiative is undertaken through continuous participation, interaction, negotiation and support of local actors (managers and health workers or developers and implementers in the case of this study) on the changes to be introduced (i.e. the new standardised data sets and reporting tools & how they are to be implemented; the application software they are expected to use in their daily routines and work practices; development tools and technologies used; and which software version to be developed). Sustaining HIS in complex settings such as the public health care system of developing countries requires careful cultivation of existing systems, structures, knowledge, and infrastructure, through negotiation, interaction and participation of all stakeholders from different social worlds (sub-worlds). As such, learning helps to understand the challenges of making an IS sustainable as well as provides the mechanisms and strategies to address those challenges.

Efforts undertaken to sustain HIS reform initiatives at a local level (such as the design and development of computerised data base, standardizing existing data collection tools, and building the capacity of domain experts to properly utilize the system) can only be achieved by introducing an approach that supports an on-going individual and collective learning through the process of communication, interaction and negotiation of different stakeholders (individuals, groups, organizations) from different social worlds (sub-worlds). It is through learning that we understand existing challenges of introducing and sustaining computerized HIS in different contexts of the public health care institutions of developing countries. Based on our understanding of the multi-faceted challenges that influence the sustainability and long-term viability of the system, we can formulate strategies to address those challenges. For example, this thesis revealed that the process of developing standardized regional data sets reporting formats and indicators in Addis

Ababa and Amhara (papers II, IV, V) through negotiation and mutual engagement of multiple stakeholders (including different vertical programs) was a learning process that helps to address the risks of sustainability and long term viability of the new standards and the system implemented. Through this negotiation and learning, vertical program managers and other stakeholders agreed to use an integrated and standardized data collection and reporting tool. Sustainability is achieved only when the stakeholders learn on the importance of the system and show their commitment to use and protect it. In the context of this study, this was achieved in some regional states, but it was not possible to get the support and commitment of the Federal Ministry of Health which had affected the long term viability and sustainability of the standards and the system implemented in those regions when the ministry decided to give national level HIS reform activities to an international consultancy firm.

Building the capacity of health workers and managers on health data management and reporting, basics of computer applications and DHIS software functionalities is also a strategy employed by HISP to support local sustainability of the system. On the part of the HISP-team members, inadequate skills and knowledge on development tools and technologies (mainly on Java) by local developers has also been a challenge in sustaining the process of developing and customizing DHIS 2.0 for the Ethiopian context. This was partly dealt by imparting technical skills and know-how on Java and other technologies through on-going in-house training, by hiring developers locally and through participatory and collaborative partnership with developers from the global HISP (mainly from Oslo and Vietnam).

Generally, I argue that it is not the technology that is sustainable (since technologies are constantly evolving); rather what need to be sustainable is the process of developing local capacity through learning and participation.

5.1.3 Implications for Information systems (IS) Research

This study has introduced the social worlds perspective to understand the dynamics of learning in the process of IS design, development and implementation in public health care settings of a developing country. By introducing the social worlds perspective as well as the notions of learning and knowing to IS research and practice in the context of developing countries; this research had contributed to information systems research in different ways. The main implications are presented as follows:

1. An important implication of this study lies in the rich empirical insights provided on learning and IS development and implementation in the context of developing countries. Though several studies are conducted on IS and developing countries (see for example Braa et al. 2004, 2007a, 2007b; Avegerou & Walsham 2002; Avegerou 2007, Bhatnagar & Bjørn-Andersen 1990) there are few studies that have explicitly explored how information systems and technical artifacts evolve through the interaction, negotiation and mutual learning of different stakeholders. To my knowledge, there is no any study that applied the social worlds perspective to understand the complex dynamics of knowing and learning in HIS development and implementation in the context of developing countries. This thesis makes an implication to IS research in the context of developing countries by introducing and enhancing the notion of social worlds as an approach to understand learning dynamics in the process of adapting and implementing IS in complex and heterogeneous organizational settings (such as the public health care system) of developing countries. More specifically, by conceptualizing HIS development and implementation as negotiated order, this thesis identified the different social worlds and sub-worlds that interact and negotiate in introducing change to existing HIS, standards and work practices and provides empirical insights on the dynamic and interactive nature of IS development and implementation. Moreover, the thesis had also revealed how boundary objects (such as technical artifacts and standards) play a significant role to mediate and facilitate the interaction and negotiation of different actors within and between different social worlds and sub-worlds in shaping information systems and work practices at a local level.

2. Though several IS researchers (such as Scott & Vessy 2000; Lyytinen & Robey 1999; Wastell 1999; Majchrzak & Beath 2000; Zong & Majchrzak 2004; Small & Sice 2008) had studied the role of learning approaches to IS development and implementation; most of those studies either focus to cognitive or practice-based perspectives rather than providing a unified view of learning and knowing. This study had contributed in revealing how information systems development and implementation serves as an arena for collaboration, negotiation and mutual knowing and learning for different individual and collective actors coming from multiple social worlds and sub-worlds. By adopting the social worlds perspective and the associated notions of tensions and conflicts, this study revealed that knowing and learning in ISD projects is an aspect of both individual cognition and situated and practice-based learning often triggered by tensions and conflicts and mediated by on-going interaction and negotiation of different stakeholders. In doing so, this research shows that IS development projects can benefit from insights of both cognitive and practice-based theories of learning and knowing. By emphasising on the importance of tensions and conflicts as triggers for learning; the study also underscored IS development and implementation as a negotiated order mediated by different boundary objects including technical artifacts and standards.

3. By introducing the social worlds perspective, this research had also challenged the conventional technology transfer approaches (see Madon et al. 2004) which often treat IS adoption and implementation as a mere transfer of technical artifacts from the North to the South. This approach as Nhampossa (2006) noted tends to overlook the negotiations and interaction required to make things work in practice at the local level of different organizational contexts. Unlike technology transfer approaches, the social worlds perspective that has been adopted in this research, treats IS adoption and implementation as a continuous process of change through local adaptation and situated learning of different stakeholders from different social worlds and sub-worlds. In this thesis, therefore, I argued that knowing and learning in IS development and implementation is emergent, situated and co-developed through communication

and negotiation of different actors. As such, technical competency and knowledge as well as best practices and experiences developed through interaction and negotiations of local actors cannot be easily transferred to new sights and locations. It should rather be integrated through a process of negotiation by different stakeholders in the new setting. This thesis, therefore, contributes by giving insights on the importance of context-sensitive knowing and learning in adopting and customizing technical artifacts, standards, and work practices in different organizational settings of the public health care system of developing countries.

5.2 Practical Implications

The use of the learning approach to IS development and implementation is a novel approach in the IS literature in general and it is of great relevance in the context of developing countries in which interdisciplinary learning, sharing of skills and knowledge among actors from different disciplines through the adoption and implementation of technology based tools and systems are not as established as they are in other countries. This thesis, therefore, has the following practical implications for IS development and implementation in the context of developing countries.

5.2.1 Enhancing multi-disciplinary collaboration and learning

Introducing IT based systems and tools in organizational contexts require interdisciplinary collaboration and learning between different stakeholders. As Olsen (2007) indicated, the increasing need for different disciplinary perspectives on technological adoption and different skills and knowledge required to address the challenges encountered suggests that a better understanding of processes of interdisciplinary learning and collaboration could be an important contribution to properly manage IS development projects. Similarly, this thesis revealed that the development and implementation of computerized HIS in public health care institutions of developing countries is an interdisciplinary collaboration and learning process. By adopting the social worlds perspective, I showed how stakeholders with different

disciplinary background (clinicians, epidemiologists, managers, statisticians, and software developers and implementers) with different interests and values collaborate and learn using various mechanisms. By doing so, the study demonstrated the inter-disciplinary character of HIS development and implementation as well as underscored the need to establish meaningful dialogue between software developers and public health domain experts working in this area. This study, therefore, contributes in enhancing the importance of multi-disciplinary collaboration and learning in developing and implementing IS in general and public health informatics in particular. Understanding the disciplinary differences, knowledge traditions, and level of competency among different actors within and between the different social worlds participating in the design, development and implementation of computerized IS helps to create conducive environment for learning and collaboration. This suggests that, those who are involved in multi-disciplinary IS development and implementation projects need to be aware about the types of learning required as well as the learning mechanisms, and should strive to create a conducive environment for inter-disciplinary learning and the co-development of new tools, standards, technologies and work practices.

Moreover, the study identified different learning mechanisms where multi-disciplinary actors from different social worlds interact, communicate and negotiate. For example, it was revealed how standardization was used as a learning mechanism where different actors with different backgrounds, knowledge traditions, and skills come together to discuss, negotiate and develop integrated data collection and reporting tools. Identifying the different learning mechanisms could give an insight to IS researchers and practitioners working in multi-disciplinary projects on how to harness different tasks and events as opportunities to establish meaningful communication and learning between different disciplines.

In a nut shell, by highlighting the need to establish synergies between IS developers and public health domain experts in the process of designing, developing and implementing IT based tools and systems to the health care sector, this thesis will contribute to provoke constructive communication and learning between the two social worlds.

5.2.2 Valuing the importance of learning to deal with the practical challenges of scaling and sustainability

Learning that is acquired through practical actions, interactions, and negotiations of different stakeholders are basically the source of understanding the challenges of scaling and sustainability. HIS development and implementation is more of a practical activity (with lots of tensions and conflicts) where stakeholders from the IS and public health domains engage in an on-going and iterative learning process. Learning can, therefore, bridge the challenges of scaling local interventions and sustaining the intervention.

In the context of HIS, for example, the problem of scaling is described in terms of spreading an HIS reform initiative from pilot area to regional and national levels (see Braa et al. 2004; Sahay & Walsham 2006). As Braa et al. (2004) indicated the scaling problem goes beyond scaling of technical artefacts to encompass all the challenges of reproducing and extending the necessary learning processes alongside the spreading of artefacts and escalating complexity. Practically, not only does scaling require the implementing team to be cognizant of the needs that should be addressed by the scaling process – technical as well as human resource needs, but they also need to be aware that as scaling occurs, complexity (linked to “institutional practices (and) politics” is likely to increase (Sahay & Walsham, 2006; Shaw, Mengiste and Braa 2007). The learning is also essential to understand how to shape and adapt the HIS to a given context, cultivate local learning processes, and institutionalise routines of use that persist over time in a local setting (see Braa et al. 2004).

The challenges of sustainability involves issues related to appropriating and adapting systems, tools, standards, technologies, and work practices to meet local requirements, identifying risks that threaten the long term viability of the system, cultivating local learning processes and institutionalizing them for local use over time (Braa et al. 2004; Korpela et al 1998). Sustainability, is therefore, not something to be achieved at the final stage of the IS development and implementation process, it is rather the result of a

continuous learning process starting from the inception of the project to its implementation and use. In this process, problems that influence the sustainability of the system will be identified and strategies formulated to address them based on shared understanding of involved actors. Learning is therefore an integral part of the strategies formulated and actions taken to deal with the risks that threaten the sustainability and long term viability of the IS initiative. For example, lack of local knowledge and competency on computing technology is one factor that influences the long term viability and usability of the computerized HIS once the system is implemented and external support is over. This problem, as it is presented in the findings of this research, has often been addressed by building local competency and capacity of end users through formal trainings and on-going on-site support to health workers and managers at district, zonal and regional levels. This study, therefore argues that, learning is an important element in addressing the practical challenges of scaling and sustaining IS in different organizational settings.

5.2.3 Managing challenges through context-sensitive strategies

As it presented in the finding of the different research papers presented in this study; one significant practical contribution of this study is analysis of context-sensitive challenges that impede the process of introducing computerized HIS in different settings of the Ethiopian public health care system. Throughout my research, I have identified challenges related to lack of standards and fragmentation of work practices, poor infrastructure as well as inadequate human resources. The empirical findings also identify some context-sensitive strategies to cope-up with the challenges faced in different settings. These strategies would have practical implication for those who are engaged in IS design, development and implementation process in resource constrained settings of developing countries. The following table (table5.1) provides a summary of some practical implications drawn from the challenges and context-sensitive strategies formulated from the empirical findings of this study.

Table 5. 1: Examples of challenges and context-sensitive strategies

<i>Challenges</i>	<i>Strategies</i>	<i>Examples from the case</i>
Fragmented HIS	Integrate data sets and data collection tools	The process of developing essential data sets in different regional states including Addis Ababa (paper V), Amhara(paper II) and Benishangul-Gumuz (paper I)
Centralized Control and lack of flexibility	Promote local cultivation rather than top-down standardization and centrally controlled system; Introduce hierarchy of standards between different levels;	The need for distributed control and local flexibility (Paper III); The strategy of cultivating local learning (paper II & IV); The use of flexible essential data sets (paper IV)
Poor infrastructure	Clustering to allow electronic data collection & analysis at a central location; use of gateways to manage differences in infrastructural access across different levels	The clustering approach introduced in Benishangul-Gumuz to cope with problems of computers and electricity at district and health facility levels (paper IV) The strategy adopted in Amhara regional state to allow paper-to-paper, paper-to-computer, and computer-to-computer communication and data interchange (paper II and IV)
Inadequate qualified manpower	Capacity building through training, Learning by doing, & On-site support; Workshops, seminars, group discussions	The strategies adopted to build local capacity in Addis Ababa, Amhara and Benishangul-Gumuz.

The strategies identified cannot be considered as universal solutions and recipes to deal with the challenges of fragmentation, centralized control, poor infrastructure and inadequate human resource in different contexts and settings. Rather, they can be used as points of departure to emphasise on the importance of developing flexible strategies to deal with context-sensitive challenges encountered in IS development and implementation in different contexts of developing countries. As such, those who are struggling to introduce change to existing IS, standards, and work practices in the context

of developing countries in general and in public health settings in particular would take a lesson on the importance of formulating strategies that took into account the local context. By being sensitive to contextual challenges, those who are involved in the process of introducing change to existing HIS, standards and work practices would formulate more sensible and meaningful approaches to the challenges and problems they encountered at a local level. For example, in settings where even access to electricity, telephone and computers is rare, it would be unrealistic to assume communication of reports between different levels of the public health care system through networks or internet facilities. In such settings, people would rather consider to adopt the clustering approach (as it was the case in Benishangul-Gumuz) or the gateway strategy (as in Amhara regional state) to facilitate the implementation process. Formulating such strategies, I argue, is a continuous and dynamic process that always take into account the existing and emergent socio-technical environment and is mediated by the interaction, negotiation and learning of different stakeholders.

5.3 Limitations of the study

This study had employed the social worlds perspective and conceptualized HIS development and implementation as negotiated order mediated by a variety of boundary objects. The thesis also investigated different tensions and conflicts as triggers to learning within and between multiple social worlds and sub-worlds by providing detailed empirical examples from the process of developing and implementing computer-based district health information systems (DHIS) in the Ethiopian context. In doing so, the thesis contributes to the debate of IS development and implementation in the context of developing countries. However, it is important to note that the findings of this study are based on experiences from the Ethiopian context, and therefore, requires more empirical grounding to generalize the findings. This necessitates the need for large scale and comprehensive research using multiple case studies in different settings and contexts in order to verify the implications of the social worlds perspective to understand complex process of knowing and learning in IS design and development in public health settings

of developing countries that are often characterized by diversity of stakeholders, complexity of structures and multiplicity of work practices, systems and standards.

Besides, although the thesis identified different sources of tensions and how they trigger learning in HIS development and implementation process; the issues of power and politics and their relationship with learning in the context of IS development and implementation was not explicitly addressed. I, therefore, suggest future research to explore the role of power and politics in knowing and learning in IS development and implementation in public health contexts of developing countries.

5.4 Concluding Remarks

This thesis has presented a theoretically and empirically informed study on the dynamics of learning in shaping technology across social worlds by taking the case of developing and implementing computerised HIS in the Ethiopian public health care context. The dilemma faced by those who are engaged in reforming health management information systems in the context of developing countries is the uncertain and unpredictable environment of public health care system of developing countries as well as uneven infrastructural development, fragmented nature of HIS and poor human resource competency across different levels. One important lesson that come out of this study is that, if ICT based initiatives are to bring real change and real practical value to institutions and users of developing countries; it is essential that technical artifacts and standards are adapted and appropriated through mutual engagement, negotiation and mutual learning of all stockholders at a local level. This thesis as such argues on the need to give emphasis on learning based approaches rather than technology transfer and diffusion of innovation approaches. This study is therefore an attempt to contribute to the body of literature concerned with a better understanding of IS development and implementation in the context of developing countries.

The core theme of this thesis is that learning within and between social worlds is an important component of IS development and implementation. Most importantly, the view of learning as a dynamic process draws attention to the individual and collective nature of learning that acknowledges knowing and learning as constituting individual cognition and collective actions, interactions and negotiation in everyday organizational life and work. As such, this thesis contributes to IS research by introducing the social worlds perspective for looking IS development and implementation as a dynamic learning process. As such, the notion of social worlds introduced in this thesis can be used as an alternative approach to investigate how learning emerges from tensions and conflicts derived from different commitments, interests and values of different stakeholders involved in IS design, development and implementation process.

The primary focus of this study has been in identifying the different tensions and conflicts and how they trigger learning among inter-disciplinary stakeholders interacting and negotiating to develop, customize and implement computerised HIS in health care institutions of the Ethiopian public health care system. The study also investigated the role of learning in understanding and addressing the challenges of cultivating existing installed bases of HIS, scaling new initiatives to different settings and sustaining them at a local level over time. The study also draws theoretical and practical implications of this research to the broader IS research and development practices in the context of developing countries.

Issues of power and politics are also addressed implicitly. As Antonacopoulou & Chiva (2007) indicated, politics reflect the dynamics that are created during negotiations of different actors to address different interest, views and values; whereas power is the medium where conflicting views, interests and values are ultimately resolved. Similarly, the findings of this thesis revealed how different tensions and conflicts among different stakeholders from multiple social worlds were resolved though negotiated order. However, the study didn't explore explicitly on the role of power and politics in influencing the learning dynamics among different stakeholder from multiple social worlds while developing and implementing computerised HIS in public health settings of developing countries.

REFERENCES

- Aanestad, M. (2002). Cultivating networks: Implementing surgical telemedicine. Faculty of Mathematics and Natural sciences, University of Oslo. PhD Thesis.
- Agar, M. (1980). Hermeneutics in anthropology: A review essay. *Ethos*, 8, 253-272.
- Ang, K.-T., Thong, J., and Yap, C. S. (1997). IT implementation through the lens of organizational learning: a case study of insurer. *Proceedings of the eighteenth International Conference on Information Systems*, December 15-17, 1997, Atlanta, Georgia, USA (pp. 331-348).
- Antonacopoulou, E. P. and Chiva R. (2007). The Social complexity of organizational learning: the dynamics of learning and organizing. *Management Learning*, 38(3): 277-295.
- Argyris, C. and Shon, D. A. (1996). Organizational Learning II. Reading, MA, Addison-Wisely. Argyris, C. and Schön, D. (1978). *Organizational learning*. London: Addison Wesley.
- Avgerou, C. and Walsham G. (2001). *Information technology in context: Studies from the perspectives of developing countries*, Ashgate, Aldershot.
- Bansler, J. P. and Haven, E. C. (2003). *Improvisation in Action: Making Sense of IS Development in Organizations*. Unpublished Manuscript. Available at URL: <http://www.vits.org/konferenser/alouis2003/html/6880.pdf>.
- Bartunek, J. M. (1984). Changing interpretive schemes and organizational restructuring: the example of religious order. *Administrative Science Quarterly*, 29, 355-372.
- Baskerville, R.L. (1999). Investigating information systems with action research. *Communications of the association for information systems*. Available from URL: http://www.cis.gsu.edu/~rbaskerv/CAIS_2_9/CAIS_2_9.html , [Accessed 10 December 2004].
- Baskerville, R. L. & Wood-Harper, A. T. (2002). A critical perspective on action research as a method for information systems research: In D. Avison & M. D: Myers (Eds.), *Qualitative Research in Information Systems* (pp. 129-145). London: Sage.
- Baxter, G. J; Connolly, T. M. & Stansfield, M. (2009). How can organizations learn: and information systems development perspective. *Learning Inquirey*, 3: 25-46.
- Bechky, B. A. (2003). Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organization Science*, 14(3): 312-330.
- Bhatnagar, S. C. & Bjørn-Andersen, N. (eds.) . 1990. *Information Technology in developing countries*. Tata McGraw-Hill, Amsterdam.
- Bloomberg, J., Giacomini, J., Mosher, A. and Swenton-Wall, P. (1993). Ethnographic field methods and their relation to design. In: Schuler, D. and Namioka, A. (eds.). *Participatory Design principles and Practices*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, publishers, pp. 123-155.
- Bødker, S. (1998). Understanding representation in design. *Human Computer Interaction*, 13(2): 107-125.
- Boland, R. J. (1985). Phenomenology: A Preferred Approach to Research in Information systems. In *Research Methods in Information Systems*, edited by Mumford, E., Hirschheim, R., Fitzgerald, G. and T.A. Wood-Harper, North Holland, Amsterdam.

- Boland; R.J. (1991). Information Systems Use as a Hermeneutic process. *In Information Systems research: Contemporary Approaches and Emergent Traditions*, edited by H-E. Nissen, H.K. Klein and R. Hirschheim, North Holland, Amsterdam.
- Bowker, G. C. , Timmermans, S. & Star, S. L. (1995). Infrastructure and organizational transformation: classifying nurses work. In: *Information Technology and Changes in Organizational Work*, Orlikowski, W., Walsham, G., Jones, M. R. & deGross, J. (Eds.), pp. 344-369. Chapman & Hall.
- Braa, J. (1997). Use and design of technology in third world contexts with a focus on the health sector: case studies from Mongolia and South Africa. Faculty of Mathematics and Natural Sciences, University of Oslo, PhD Thesis
- Braa, J. and Blobel, B. (2003). Strategies for developing health information systems in Developing Countries. Report from WITFOR Health Commission.
- Braa, J. and Hedberg, C. (2002). The struggle for district-based health information systems in South Africa. *The Information Society*, 18: 113-127.
- Braa, J., Macome, E., Costa, J. L. D., Mavimbe, J. C., Nhampossa, J. L., Jose, B., Manave, A. , & Sitori, A. (2001). A study of the actual and potential usage of information and communication technology at district and provincial levels in Mozambique with a focus on the health sector. The electronic journal of Information Systems in Developing Countries, 5(2). Available at URL: <http://www.ejisd.org/> (last accessed January 2009).
- Braa, J., Monteiro, E. and Reinert, E. (1995). Technology Transfer vs. Technological learning: IT infrastructure and health care in Developing Countries. *Information Technology for Development*, 6(1): 15-23.
- Braa, J., Monteiro, E., Sahay S. (2004). Networks of Action: Sustainable Health Information system across developing countries, *MISQ*, 28: 337-362.
- Braa, J.; Hanseth, O.; Heywood, A.; Mohammed, W.; Shaw, V. (2007a). Developing health information systems in developing countries: the flexible standards strategy. *MIS Quarterly*, Special Issue, 31, 1-22.
- Braa, J.; Monteiro, E.; Sahay, S.; Staring, K.; & Titlestad, O. H. (2007b). Scaling up local learning-experiences from South-South_North Networks of shared software development. Proceeding of IFIP 9.4, Sao Paulo, Brazil.
- Briers, M. & Chua, W. F. (2001). The role of actor networks and boundary objects in management accounting change: A field study of an implementation of activity-based costing. *Accounting Organizations & Society*, 26, 237-269.
- Brown, J. S. and Duguid, P. (1991). Organizational learning and communities of practice: toward a unified view of working, learning, and innovation. *Organization Science*, 2: 40-57.
- Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: boundary objects in new product development. *Organization Science*, 13, 442-455.
- Central Statistical Agency of Ethiopia (CSA). (2008). Population and Housing Census. Addis Ababa, Ethiopia.
- Chekol, Abebe. (2007). A report on the Ethiopian Free and Open Source Software Network (EFOSSNet). Available at URL: <http://www.giswatch.org/download>.
- Chen, W. and Hirschheim, R. (2004). A paradigmatic and methodological examination of information systems research from 1991 to 2000. *Information Systems Journal*, 14: 197-235.

- Chilundo, B. (2004). Integrating Information Systems of Disease-Specific Health Programmes in Low Income Countries: The case of Mozambique. Faculty of Medicine, University of Oslo, PhD Thesis.
- Chiva, R. and Alegre, J. (2005). Organizational learning and organizational knowledge: Towards the integration of the two approaches. *Management Learning*, 36, 49-68.
- Cibora, C. & Lanzara, G. F. (1994). Formative Contexts and information technology. *Accounting, Management and Information Technology*, 4: 611-626.
- Clarke, A. (1991). Social worlds/arenas theory as organizational theory. In Maines, D. (ed.) *Social organization and social process: essays in honor of Anselm Strauss*. Hawthorne (NY): Aldine de Gruyter, pp.119-158.
- Cohen, M. D. and Bacdayan, P. (1994). Organizational routines are stored as procedural memory: evidence from a laboratory study. *Organizational Science*, 5, 554-568.
- Cook, S. D. N. & Brown, J. S. (1999). Bridging epistemologies: the generative dance between organizational knowledge and organizational knowing. *Organizational Science*, 10(4): 381-400.
- Cook, S. D. N., & Yanow, D. (1993): Culture and organizational learning. *Journal of Management Inquiry*, 2(4): 373-390.
- Creswell, John W. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Second edition, London: sage.
- Crossan, M., and Guatto, T. (1996). Organizational learning research profile. *Journal of Organizational Change Management*, 9(19): 107-112.
- Curtis, B., Krasner, H., and Iscoe, N. (1988). A field study of the software design process for large systems. *Communications of the ACM*, 31(11): 1268-1287.
- Cyert, R. M. & March, J. G. (1963). *A Behavioral theory of the firm*. Englewood cliffs, New Jersey: Prentice-Hall.
- Dahlbom, B. & Janlert, L-E. (1997). Computer future. Unpublished manuscript, Department of Computing Science; Umeå University, Umeå.
- Alma-Ata International Conference on Primary Health care declaration (1978). Alma-Ata, USSR, 6-12 September 1978. Available at URL: http://www.who.int/hpr/NPH/docs/declaration_almaata.pdf
- Deetz, S. (1996). Describing Differences in Approaches to organization Science: Rethinking Burrell and Morgan and their Legacy, *Organizational Science* 7: 191-207.
- Demeke, M. & Birru, T. (2002). ICT penetration and usage in Ethiopia: Baseline study. The SCAN-ICT project, Addis Ababa: Ethiopia.
- Dodgson, M. (1993). Organizational learning: a review of some literatures. *Organizational Studies*, 13, 375-394.
- Duncan, R. & Weiss, A. (1979). Organizational learning: implications for organizational design. In B. M. Staw (Ed.), *Research in Organizational Behaviour*, vol. 1: 75-123: Greenwich, Connecticut: JAI press.
- Easterby-Smith, M. (1997). Disciplines of organizational learning: contributions and critiques. *Human Relations*, 50(9): 1085-1113.
- Easterby-Smith, M.; Crossan, M. & Nicolini, D. (2000). Organizational learning: Debates past, present and future. *Journal of Management Studies*, 37(69): 783-796.

- Easterby-Smith, M; Burgoyne, J.; & Araujo, L. (1999). Organizational learning and the learning organization. London: sage Publications.
- Edmondson, A. & Moingeon, B. (2003). From organizational learning to the learning organization. In Christopher Gray and Elena Antonacopoulou (eds.) *Essential Readings in Management Learning*, London, Sage.
- Edmondson, A. (1999). Psychological safety and learning behaviour in work teams. *Administrative Science Quarterly*, 44: 350-383.
- Education Sector Development Programme (ESDP)- Federal Democratic Republic of Ethiopia. (2007). Addis Ababa, Ethiopia
- Elkjaer, B. & Huysman, M. (2008). *Social Worlds Theory and the Power of Tension*. London: Sage Publications. In: Barry, D., *The SAGE Handbook of New Approaches in Management and Organisations* (170-177).
- Elkjaer, B. (1999). In search of a Social Learning Theory. In M. Easterby-Smith, L. Araujo and J. Burgoyne (eds.) *Organizational Learning and the Learning Organization*, London, Sage.
- Elkjaer, B. (2003). Social learning theory: learning as participation in social processes. In: M. Easterby-Smith, and M. Lyles (eds.) *The Blackwell Handbook of Organizational Learning and Knowledge management*, PP. 38-53. Oxford: Blackwell Publishing.
- Elkjaer, B. (2004). Organizational learning: 'The Third Way'. *Management Learning*, 35(4): 419-434
- Elkjaer, B. (2005). From digital administration to organizational learning. *Journal of Workplace Learning*, 17(8); 533-544.
- Ellingsen, G., & Monteiro, E. (2003). Big is beautiful. Electronic patient records in Norway 1980-2000. *Methods of Information in Medicine*, 42, 366-370.
- Engestrom, Y. (2004). New forms of learning in co-configuration work. *Journal of Workplace Learning*, 16, 2-10.
- Fine, G.A. (1984). Negotiated orders and organizational cultures. *Annual Review of Sociology*, 10: 239-262.
- Fiol, C. M. & Lyles, M. A. (1985). Organizational Learning. *Academy of Management Review*, 10(4): 803-813.
- Fitzpatrick, g., Kaplan, S. & Mansfield, T. (1996). Physical Spaces, virtual places and social worlds: A study of work in virtual. *Proceedings of the 1996 ACM conference on Computer supported cooperative work*, pp. 334-343.
- Fujimura, J. H. (1992). Crafting Science: Standardized packages, boundary objects and translations. IN: Andrew Pickering (ed.), *Science as Practice and Culture*. Chicago: University of Chicago Press: 168-211.
- Gal, U., Yoo, Y., & Boland, R. J. (2004). The dynamics of boundary objects, social infrastructures and social identities. *Sprouts: Working Papers on Information System*, Case western Reserve University, USA. Available at URL: <http://sprouts.case.edu/2004/040101.pdf>
- Gardner, R.; Nicolini, D.; Gerhardi, S.; and Yanow, D. (eds). (2003). *Knowing in Organizations: a practice-based approach*. New York: M.E. Sharpe.
- Garratt, B. (1999). The Learning Organization 15 years on: Some personal reflections. *The Learning Organization*, 6(5): 202-206.

- Garvin, D.A. (1993). Building a learning organization. *Harvard Business Review*, July–August, 78–91
- Gherardi, S. (2000). Practice-based theorizing on learning and knowing in organizations: An introduction. *Organization*, 7: 211–24.
- Gherardi, S. (2001). From organizational learning to practice-based knowing. *Human Relations*, 54(1): 131-139.
- Gherardi, S. (2006). *Organizational knowledge: the texture of workplace learning*. Oxford, UK: Blackwell.
- Gherardi, S. and Nicolini, D. (2002). Learning in constellation of interconnected practices: canon or dissonance? *Journal of Management Studies*, 39(4): 419-436.
- Gherardi, S., Nicolini, D. and Odella, F. (1998). Toward a social understanding of how people learn in organizations. *Management Learning*, 29: 273-297.
- Gnyawali, D. R. (1999). Inter-organizational learning dynamics: Roles of networks on knowledge creation. Available at URL: [http://notes.lancs.ac.uk/pub/ol3.nsf/0/2900de6351042d958025676100505844/\\$FILE/Gnyawali.pdf](http://notes.lancs.ac.uk/pub/ol3.nsf/0/2900de6351042d958025676100505844/$FILE/Gnyawali.pdf) (Accessed November 2008)
- Greeno, J. G. (1989). A perspective on thinking. *American Psychologist*, 44: 134-141.
- Grey, C. and Antonacopoulou, E.P. (2004). *Essential Readings in Management Learning*. London: Sage.
- Hager, P. (2005). Current theories of workplace learning: a critical assessment: In: Basica, N., Cumming, A., Datnow, A., leithwood, K., and Livingstone, D. (eds.), *International Handbook of Educational Policy*, Springer, Dordrecht/Boston, MA/London.
- Handley, K. et al. (2006). Within and beyond communities of practice: Making sense of learning through participation, identity and practice. *Journal of Management Studies*, 43(3): 641-653.
- Hanseth, O. & Aanestad, M. (2003). Bootstrapping networks, communities and infrastructures: On the evolution of ICT solutions in healthcare: *Methods of Information in Medicine*, 42, 385-391.
- Hanseth, O. (2002) From systems and tools to networks and infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology implications. Working paper, University of Oslo.
- Hanseth, O. and Lyytinen, K. (2004). Theorizing about the design of Information Infrastructure: design Kernel theories and principles. Unpublished work. Available at URL: <http://sprouts.aisnet.org/4-12> (Accessed March 2009).
- Hanseth, O., and Monteiro, E. (1998). *Understanding Information Infrastructure*. Manuscript. Available at URL: <http://heim.ifi.uio.no/~oleha/publications/bok.pdf> (Accessed February 2009).
- Hanseth, O., Monteiro, E. and Hatling, M. (1996). Developing information infrastructure: the tension between standardization and flexibility. *Science, Technology and Human Values*, 2(4): 407- 426.
- He, J. (2004). Knowledge impacts of user participation: a cognitive perspective. *Proceedings of SIGMIS April 22-24, 2004 Tucson, Arizona, USA*, pp. 1-7.

- Hedberg, B. (1981). How organizations learn and unlearn. In: P. C. Nystrom, & W. H. Starbuck, *Handbook of Organizational Design* (PP. 3-27). New York: Oxford University Press.
- Heeks, R. (2002). Information systems and developing countries: failure, success and local improvisations. *The information Society*, 18, pp. 101-112.
- Heeks, R. and Bark, E (1999) Evaluation of donor funded technology projects in China, Working paper, Institute for Development Policy and Management (IDPM), University of Manchester, Manchester.
- Heeks, R.; Mundy, D.; and Salazar A. (1999). Why health care information systems succeed or fail. Institute for development Policy and management; University of Manchester: Manchester, UK. Available from URL: <http://unpan1.un.org/intradoc/groups/public/documents/NISPAcee/UNPAN015482.pdf>
- Henderson, K. (1998). The role of material objects in the design process: a comparison of two design cultures and how they contend with automation. *Science, Technology & Human Values*, 23, 139-174.
- Henriksson, K. (1999). The collective dynamics of organizational learning: On plurality and multi-social structuring. Lund: Lund University press.
- HSDP-III (2005). Health Sector Strategic Plan. Federal Ministry of Health, Addis Ababa, Ethiopia.
- Huber, G. P. (1991). Organizational learning: The contributing processes and the literature. *Organization Science*, 2(1): 88-115.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT press.
- Huysman, M. & Elkjaer, B. (2006). Organizations as arenas of social worlds: towards an alternative perspective on organizational learning? Proceedings of the International Conference on Organizational Learning, Knowledge and Capabilities (OLKC) University of Warwick, Coventry, UK. Available at URL: <http://www.olkc.net/> (accessed June 2008).
- Huysman, M. (2000). Rethinking organizational learning: Analysing learning processes of information system designers. *Accounting; Management and Information Technology*, 10: 81-99.
- ICT Development Agency (ICTDA)- Ethiopia. (2007). ICT Assisted Development project: Monitoring and evaluation report on information need of farmers and pastoralists, Addis Ababa, Ethiopia. Available at URL: <http://www.ictadethiopia.org/documents/202da165a25345d90045cfa7d290f716359c8c06.pdf>.
- Jensen, C. B. & Markussen, R. (2007). The unbearable lightness of organizational learning theory: organizations, information technologies, and complexities of learning theory in theory and practice. *Learning Inquiry*, 1: 203-218.
- Kaplan, B. and Maxwell, J. A. (1994): *Qualitative research methods for evaluating computer information systems*, In *Evaluating Health Care Information Systems: methods and Applications*, edited by J. G. Anderson, C.E. Aydin and S.J. Jay, Sage, Thousand Oaks, CA.
- Kim, D. M. (1993). The link between individual and organizational learning. *Sloan Management Review*, 37-50.
- Kimaro, H. C. (2006). Decentralization and sustainability of ICT based health information systems in developing countries: A case study from Tanzania. Faculty of Mathematics and Natural Sciences, University of Oslo. PhD Thesis.

- Kimaro, H. C., Mengiste, S. A. and Aanestad, M. (2008). Redesigning Health Information Systems in developing Countries: the need for local flexibility and distributed control. *Public Administration and Development*, 28: 18-29.
- Kimaro, H. C. and Nhampossa, J. L. (2005). Analysing the problem of unsustainable health information systems in less-developed economies: case studies from tanzania and Mozambique. *Information Technology for Development*, 11(3): 273-298.
- Klein, H.K. and Myers, M.D. (1999). A set of principles for conducting and evaluating interpretive filed studies in information systems. *MIS Quarterly*, 23(1): 67-93.
- Korpela, M., Soriyan, H. A., Olufokunbi K.C., Onayade, A.A., Davies-Adetugbo, A. and Adesanmi, D. (1998) Community participation in health informatics in Africa: and experiment in tripartite partnership in Ile-Lfe, Nigeria. *Computer Supported Cooperative Work*, 7 (3-4),: 341-361.
- Koskinen, K. U. & Makinen, S. (2009). Role of boundary objects in negotiations of project contracts. *International Journal of Project Management*, 27: 31-38.
- Lant, T. K. & Mezias, S. J. (1992). An organizational learning model of convergence and reorientation. *Organizational Science*, 3, 47-71.
- Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Lave, J. (1988). *Cognition in practice: Mind , Mathematics and Culture in everyday life*. Cambridge University Press: Cambridge, MA.
- Leonard_Barton, D. (1995). *Wellsprings of knowledge: Building and sustaining the sources of innovation*. Harvard Business School Press, Boston, MA.
- Levitt, B. & March, J. G. (1988). Organizational learning. *Annual review of Sociology*, 14: 319-340.
- Lewis, J. (2008). Understanding “Hybrid Knowledge” in the context of health information systems in developing countries: Case studies from the Indian public health sector. Unpublished Manuscript, University of Oslo, Department of Informatics.
- Lippeveld, T., Sauerborn, R. and Bodart, C. (eds.) (2000). *Design and Implementation of Health Information Systems*. World Health Organization (WHO), Geneva.
- Lungo, J. H. (2008). *Design-reality gaps in open source information systems development: An action research study of education and helath care systems in Tanzania*. Faculty of Mathematics and Natural sciences, University of Oslo. PhD Thesis.
- Lyytinen, K. 1987. Different perspectives on Information systems: problems and solutions. *ACM Computing Surveys*, 19(1): 5-46.
- Lyytinen, K. and Robey, D. (1999). Learning failure in information systems development. *Information Systems Journal*, 9: 85-101.
- Mackenzie, D. (1999). Technological determinism. In: W. H. Dutton (Ed.), *Society on the Line: Information Politics in the Digital Era*, Oxford University Press, Oxford, pp. 39-41.
- Madon, S. Sahay, S. & Sahay, J. (2004). Implementing property tax reforms in Bangalore: an actor-network perspective. *Information and Organization*, 14, 269-295.

- Majchrzak, A. & Beath, C. M. (2000). Beyond user participation. A model of learning and negotiation during systems development. In: Zmud R. W. (ed.) Workshop on Redefining the organization role of Information Technology in the Information Age; Noraman, OK.
- Majchrzak, A., Beath, C. Lim, R.A. and Chin, W.W.. (2005). Managing client dialogues during information systems design to facilitate client learning. *MIS Quarterly*, 29, 653-672.
- March, J. G. (1991). Exploration and exploitation in organizational learning. *Organizational Science*, 2, 71-87.
- March, J. G. and Olsen, J.P. (1975). *Ambiguity and Choice in Organizations*. Bergen, Norway, Universitetsforlaget.
- Mark, G. & Poltrock, S. (2004). Groupware adoption in distributed organization: transporting and transforming technology through social worlds. *Information and Organization*, 14: 297-327.
- Marshall, N. (2008). Cognitive and practice-based theories of organizational knowledge and learning: incompatible or complementary? *Management Learning*, 39(4): 413-435.
- Mathiassen, L. & Pedersen, K. (2005). The dynamics of knowledge in systems development practice. Proceedings of the 38th Hawaii International Conference on System Sciences. 3-6 January 2005, Big Island, Hawaii, USA, 11 p.
- Miner, A. S., & Mezas, S., J. (1996). Ugly duckling no more: pasts and futures of organizational learning reserach. *Organization Science*, 7(1): 88-99.
- Ministry of Finance and Economic Development (MoFED) [Ethiopia]. (2007). Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP). Annual Progress Report 2006/07, Addis Ababa, Ethiopia.
- Ministry of Information (MoI) [Ethiopia].(2004). Facts about Ethiopia. Press and Audiovisual Department, Ministry of Information, Addis Ababa, Ethiopia.
- Modell, S. (2006). Institutional and negotiated order perspectives on cost allocations: the case of the Swedish University sector. *European Accounting Review*, 5(2): 219-251.
- Monteiro, E. (1998). Scaling Information Infrastructure: The Case of the Next-Generation IP in the Internet. *The Information Society*, 14(3), 229-245.
- Mosses, E. and Sahay, S. (2003). Counter networks, communication and health information systems: A case study from Mozambique. In: M. korpela, R. Montearlegre, & A. Poulymenakou (eds.), Proceedings of the IFIP TC8 & TC9/WG 8.2 + 9.4 Working Confrence on Information Systems Perspectives and Challenges in the Context of Globalization, Athens, greece. Kluwer.
- Mumford, A. (2001). Individual and Organizational learning: the pursuit of change. In: C. Mabey & P. Iles (eds.), *Managing Learning* (pp. 77-86). London: International Thomson Business Press.
- Mussa, M. (2003). Application of ICTs for improved health service deliveries in Ethiopia. Minsitry of capacity Building, ICT capacity building program, Addis Ababa: Ethiopia.
- Myers, M. D. (1997). Qualitative Research in Information system. Available from: <http://www.aucland.ac.nz> [Accessed March 2004].

- Myres, M. D. & Avison, D. (2002). *Qualitative research in Information Systems: A reader*. Sage publications, London, UK.
- Newman, M. & Nobel, F. (1990). User involvement as an interaction process: A case study. *Information Systems Research*, 1: 89-113.
- Nhampossa, J. L. (2006). *Re-Thinking Technology Transfer as Technology Translation: A Case Study of health Information systems in Mozambique*. Faculty of Mathematics and Natural sciences, University of Oslo. PhD Thesis.
- Nicolini, D. & Meznar, M. B. (1995). The construction of organizational learning: concepts and practical issues in the field. *Human Relations*, 48(7): 727-746.
- Nicolini, D.; Gherardi, S.; & Yanow, D. (eds) (2003). *Knowing in Organizations. A practice based approach*. Armonk, NY: M.E. Sharpe.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1): 14-37.
- Odedra, M. (1991). Information technology transfer to developing countries: Is really taking place? In Berleur, J. & Drumm, J. (eds.) *The 4th IFIP-TC9 International Conference on Human Choice and Computers*. North-Holand, Amsterdam, Netherlands, HCC 4 held jointly with the CEC FAST programme.
- Olson, D. S. (2009). Connecting different disciplines to develop new technology: making nanomaterials to combat bird-flu. Proceedings of the International Conference on Organizational Learning, Knowledge and Capabilities (OLKC), Amesterdam, Netherlands. Available at URL: <http://www.feweb.vu.nl/olkc2009/papers.html#1B> (Accesed May 2009).
- Orlikowski, W. J. & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, 2: 1-29.
- Orlikowski, W., J. (2002). Knowing in practice: Enacting a collective capability in distributed organizing. *Organization Science*, 13(3): 249-273.
- Pagliari, C. (2007). Design and evaluation of ehealth: Challeges and implications for an interdisciplinary field. *Journal of Medical Internet Research*, 9(2): e15.
- Pasteur, K. (2004). Learning for development: a literature review. Lessons for change in policy in organizations No.6. Brighton: Institute of Development Studies.
- Pawlowski, S. D. & Robey, D. (2004). Bridging user organizations: Knowledge brockering and the work of information technology professionals. *MIS Quarterly*, 28(49): 645-672.
- Pedler, M., & Aspinwall, K. (1998). *A concise guide to the learning organization*. London: Lemos & Crane.
- Perrow, C. (1986). Economic theories of organization. *Theory and Society*, 15(172): 11-45.
- Pirinen, A. & Pekkola S. (2006). Different perspectives on Learning in Information System development. Proceedings of IRIS'29, the 29th Information Systems Research Seminar in Scandinavia, Helsingøre, Denmark, August 12-15.
- Prange, C. (1998). Organizational learning: desperately seeking theory. In M. Easterby-Smith, L. Araujo & J. Burgoyne, *Organizational Learning and the learning organization: developments in theory and practice*. London: Sage publications.

- Rahaman, A. S. & Lawrence, S. (2001). A negotiated order perspective on public sector accounting and financial control. *Accounting, Auditing and Accountability Journal*, 14, 147-165.
- Reynolds, J., Stinson, W. (1993). Sustainability analysis. *Primary Healthcare Management Advancement Programme*, Aga Khan Foundation, Bangkok.
- Richter, I. (1998). Individual and Organizational learning at the executive level. Towards a research agenda. *Management Learning*, 29(3): 299-316.
- Robey, D., Boudreau, M.C., Rose, G.M. (2000). Information technology and organizational learning: A review and assessment of research. *Accounting, Management and Information Technologies*, 10, 125-155.
- Rogers, E. M. (1983). *Diffusion of Innovations*, New York, The Free Press.
- Rolland, K. H. and Monteiro, E. (2002). Balancing the local and the global in infrastructural information systems. *The Information Society*, 18: 87-100.
- Roth, W.-M. & McGinn, M. K. (1998). Inscriptions: toward a theory of representing as social practice. *Review of Educational Research*, 68(1): 35-59.
- Sahay, S. (2001). Special issue on "IT and Health Care in Developing Countries." *Electronic Journal of Information Systems in Developing Countries*, 5, 1-6.
- Sahay, S. and Avgerou, C. (2002). Introducing the special issue on Information and Communication Technologies in Developing Countries. *Information Society* 18(2): 73-76.
- Sahay, S. and Walsham, G. (2006). Scaling of Health Information Systems in India: Challenges and approaches. *Information Technology for Development* 12(3): 185-200.
- Scott, J. E. & Vessy, I. (2000). Implementing Enterprise Resource Planning Systems: The role of learning from failure. *Information Systems Frontiers*, 2(2): 213-232.
- Senge, P. M. (1990). *The Fifth discipline: The art and practice of the learning organization*: new York: Doubleday Currency.
- Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 27(2): 4-13.
- Shaw, V. (2005). Health Information System reform in South Africa: developing an essential data set. *Bulletin of the World Health Organization*, 2005(839): 632-639.
- Shaw, V., Mengiste, S. A., and Braa, J. (2007). Scaling of health information systems in Nigeria and Ethiopia- considering the options. *Proceedings of the IFIP WG 9.4 conference*, Sao Paulo, Brazil, 28-30 May 2007.
- Shrivastava, P. (1983). A typology of organizational learning systems. *The Journal of Management Studies*, 20(1): 7-28.
- Silverman, D. (2001). *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*. Second edition, London: Sage.
- Simon, H. A. (1991). Bounded rationality and organizational learning. *Organization Science*, 2(1): 125-134.
- Skerlavaji, M. and Dimovski, V. (2007). Towards network perspective of intra-organizational learning. Bridging the gap between acquisition and participation perspective. *Interdisciplinary Journal of Information, Knowledge, and Management*, 2: 43-58.
- Small, A. and Sice, P. (2008). A framework for promoting learning in IS design and implementation. *The Learning Organization*, 15(2): 149-178.

- Sørensen, K. H. (1998). Learning technology, constructing culture: Socio-technical changes as social learning. Available at URL: <http://www.rcss.ed.ac.uk/SLIM/public/phase1/knut.html> [retrieved on 27.05.2009].
- Stake, R. (1994). Case studies. In: Denzin, N. & Lincoln, Y. Handbook of Qualitative Research. Thousand oaks, CA: Sage publications, 236-247.
- Star, S. S. and Griesemer, J.R. (1989). Institutional ecology, translations and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology, 1907-1939. *Social Studies of Science*, 19: 387-420.
- Stein, E. W. and Vandenbosch, B. (1996). Organizational learning in advanced systems development: opportunities and obstacles. *Journal of Management Information Systems*, 13: 115-136.
- Strauss, A. (1978). A social world perspective. In studies in symbolic interaction, volume 1, edited by Norman Denzin. Greenwich, CT: JAI press.
- Strauss, A. (1984). Social worlds and their segmentation process. In studies in symbolic interaction, volume 5, edited by Norman Denzin. Greenwich, CT: JAI press.
- Strauss, A. (1991). Scientists and the evolution of policy arenas: the case of AIDS. Paper presented at the Stone Symposium of the Society for the Study of Symbolic Interaction, San Francisco.
- Swanson, E. B., & Ramiller, N. C. (2004). Innovating mindfully with technology. *MIS Quarterly*, 28(4): 553-583
- Thomas, J. (1984). Some aspects of negotiated order, loose coupling and mesostructure in maximum security prisons. *Symbolic Interaction*, 7(2): 213-231.
- Thompson, M. (2005). Structural and epistemic parameter in communities of practice. *Organization Science*, 16(2): 57-91.
- United Nations Development Program (UNDP. (2007/08). Human Development Report-Ethiopia.
- United Nations Economic Commission for Africa- African Development Forum (UNECA-ADF). (2000). Information and Communication Technology for health sector. Available at URL: <http://www.uneca.org/adf99/adf99health.htm> (accessed June 2008).
- United Nations Educational, Scientific and Cultural Organization (UNESCO).(1999). Ethiopia- UN Country team: common country assessment (CCA). Addis Ababa , Ethiopia
- Valentin, F., Larsen, M. T., Alkærsig, L. (2008). Breakthroughs and interdisciplinary research- the case of research behaviour in transitional medical science. Paper presented at the DRUID conference, Copenhagen, Denmark.
- Vital Wave Consulting. (2009). Health Information Systems in Developing Countries: A landscape analysis.
- Walsham, G. (1993). Interpreting Information Systems in Organizations, John Wiley and Sons, New York, USA.
- Walsham, G. (1995a). Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*, 4: 74-81.

- Walsham, G. (1995b). The Emergence of Interpretivism in IS Research, *Information Systems Research*, 6: 376-394.
- Walz, D., Elam, J. & Curtis, B. (1993). Inside a software design team; knowledge acquisition, sharing and integration. *Communications of the ACM*, 36(10): 63-77.
- Wastell, D. (1999). Learning dysfunctions in information systems development: Overcoming the social defences with transitional objects. *MIS Quarterly*, 23(4): 581-600.
- Wastell, D. and Newman, M. (1993). The behavioural dynamics of information system development: A stress perspective. *Accounting, Management and Information Technology*, 3(2): 283-300.
- Weick, K. E. & Roberts, K. (1993). Collective mind and organizational reliability: the case of flight operations in an aircraft carrier deck. *Administrative Science Quarterly*, 38: 357-381.
- Weick, K. E. & Sutcliffe, K. M. (2001): Managing the unexpected: assuring high performance in an age of complexity. Jossey-Bass, San Francisco.
- Weick, K. E. & Westley, F. (1996). Organizational Learning: affirming an oxymoron. In: S. R. Clegg, C. Hardy & W. R. Nord, Handbook of Organization Studies. London: Sage Publications.
- Weick, K. E. (1995). Sensemaking in Organizations. Thousand Oaks, CA: SAGE.
- Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (1999). Organizing for High Reliability: Processes of Collective Mindfulness. *Research in Organizational Behavior*, 21: 81-123.
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7(29): 225-246.
- Wenger, E. (1998). Communities of practice: Learning, Meaning and Identity. Institute for research and Learning, Cambridge University Press.
- World Bank. (2007). Country report for Ethiopia: Joint Evaluation of the Trust Fund for Environmentally and Socially Sustainable Development (TFESSD).
- World Health Organization (WHO). (1994). Information support for new public health action at the district level. Report of the WHO Expert Committee. WHO Technical Report Series, No. 845, pp. 1-31, Geneva.
- World health Organization- Health Metrics Network (HMN). (2008). Framework and Standards for Country Health Information Systems, sec. 1.1.1. Available at URL: whqlibdoc.who.int/publications/2008/9789241595940_eng.pdf (Accessed March 2009)
- World Health Organization- Health Metrics network (WHO-HMN). (2007). Assessment of the Ethiopian Health Information System: Final Report. Available at URL: http://www.who.int/healthmetrics/library/countries/hmn_eth_his_2007_en.pdf (Accessed March 2009)
- Yanow, D. (2000). Seeing Organizational learning: a cultural view. *Organization Science* 7(2): 247-268.
- Yin, R. (1994). Case study research: design and methods. Sage, Newbury Park, CA.
- Zong, J. & Majchrzak, A. (2004). An exploration of impact of cognitive elaboration on learning in ISD projects. *Information Technology and Management*, 15: 143-159.

APPENDIXES

APPENDIXES I

Mengiste, S. A. (2005). Challenges and Opportunities of Implementing District-based Health Information System in Ethiopia: A case study from Benishangul-Gumuz Region. In: Bada, A. & Adalakun, O. (eds.), *Proceedings of the IFIP W:G 9.4 Working Confrence on enhancing human resource development through ICT*. Abuja, Nigeria, pp.

Challenges and Opportunities of Implementing District-based Health Information System in Ethiopia: A case study from Benishangul-Gumuz Region.

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IFIP W:G 9.4 Working Confrence on enhancing human resource development through ICT

ABSTRACT

This paper has analyzed the challenges of sustainability and scalability of HIS. The empirical analysis was conducted in a backward and disadvantaged region of Ethiopia. An ongoing process of HISP (Health Information System Program) was addressed and the main challenges in the implementation of sustainable and scalable district-based health information system in the context of Primary Health Care (PHC) sector in Ethiopia were identified. Human resource, infrastructure, and HIS related problems are the main challenges hindering the implementation of sustainable and scalable district-based health information systems in the region.

Key words: District.based HIS, Implementation, Challeges and opportunities, Benishangul-Gumuz

INTRODUCTION

The delivery and management of health services to deprived communities and regions in developing countries is a truly complex task (Braa, et al 2004). Many developing countries including Ethiopia are experiencing serious problems of providing their populations with adequate Primary Health Care (PHC) services. The 1978 World Health Organization (WHO) conference in Alma Ata, Kazakhstan, concluded PHC should be organized as a decentralized system with a focus on preventive care. The basic tenets are that health services should be offered and managed for and from small demographic and geographic areas to achieve effective communication both with higher and lower levels; be close enough to communities to understand and act upon their problems, and be able to handle the decentralization of resources and decision making. Within this context, a Health Information System (HIS) that captures and uses data at the local level is very crucial to assist in making appropriate healthcare policy at all levels within the type of decentralized systems suggested by WHO. As Braa et al (2004), point out, there is a growing recognition by international agencies, notably the WHO, government authorities, and

researchers from different domains including information systems (IS), development theory, and public health that improved HISs can significantly contribute to help address health service delivery problems in the context of developing countries. To successfully achieve this, Amoono-Lartson et.al (1984), suggest “bottom-up”, instead of “top-down”, planning in order to assess the needs, resources, and opportunities at the community level.

A district-based health system to ensure decentralized management and coordination of health services and advocated as the appropriate level for HIS development (WHO 1988, 1994; Lippeveld et al 2000), has been problematic to achieve in practice (Lippeveld et al 2000). Some of the reasons constituting to this include: the intrinsically centralized and fragmented character of health services, lack of coordination, poor quality and use of information, and the complex organizational context of the health sector (Avgerou and Walsham, 2000). Braa et al (2004) identified two broad themes underlying the unsuccessful attempts with HIS in developing countries. The first concerns the challenge of sustainability to make an IS work, in practice, over time, in a local setting. This involves shaping and adapting the systems to a given context, cultivating local learning process and institutionalizing routines of use that persist over time. They call it the problem of *sustainability*. The second challenge is that of *scalability* which is related to the problem of how to make one, working solution spread to other sites, and be successfully adapted there. Drawing on these ideas this paper was initiated to explore the opportunities and challenges of implementing sustainable and scalable district based HIS in the Ethiopian Public Health Sector context.

The aim of this paper, then, is to explore the challenges and opportunities for implementing sustainable and scalable HISs in the Ethiopian health care system in general and in one remote and disadvantaged region (Benishangul-Gumuz) in particular. Through an empirical analysis of ongoing efforts in the implementation of computer-based district health information system in Ethiopia within the umbrella of HISP-Ethiopia, the paper analyses the case of one disadvantaged region. The paper addresses the following research questions:

- How is the existing HIS functioning in Benishangul-Gumuz region (organizational structure and flow of health information at different levels)?
- What are the challenges and opportunities for developing sustainable and scalable computer-based HIS in Ethiopia in general and in Benishangul-Gumuz region in particular?

Significance of the Paper

Implementation of sustainable and scalable computer-based HIS in the context of developing countries has proven to be problematic due to various reasons. One of the main challenges of introducing sustainable and scalable IS in many developing countries is lack of trained and skilled human resources that identifies the impacts, challenges and opportunities of new technologies and deals with those technologies and exploit their potentials to address local problems over time. This paper addresses human resource as one of the main challenges in HIS implementation and how to deal with such challenges in implementing sustainable and scalable HIS in the Ethiopian public Health Care context.

The rest of the paper is organized as follows. In the second section, I describe the theoretical concepts related to sustainability and scalability of HIS. The subsequent section, presents the research approach adopted for this study and data collection and analysis methods. In section

four, the case study is presented and in the last section, I present the case analysis, discussion and conclusions.

2. THEORETICAL FRAMEWORK

2.1 Sustainability

The term sustainability can have different meanings, and often implies maintaining something that already exists over time, or is often equated with 'self-sustaining' and 'self-sufficient', which means that no outside support is needed to continue its existence (Reynolds and Stinson, 1993). However, with regard to IS, 'sustainability' means the ability to identify and manage risks threatening the long-term viability of the project (Korpela *et al* 1998). Misund and Høiberg (2003) defined sustainable IT as technology that is capable of being maintained over long span of time independent of a shift in both hardware and software. Sustainability can be seen as a process, starting from the inception of the system, to the various processes around design, development, support and implementation. Sustainability concerns the longevity of these processes and how they co-exist over time, especially once external support is withdrawn (Braa *et al* 2004). The challenge concerns how the system continues or does not continue to live on within the organization, in a manner in which it effectively supports decision making needs at different levels. Kimaro and Nhampossa (2004) argued that for the sustainability of HIS to be achieved, the interests and resources of all involved actors must be aligned. Actors' interests, knowledge and resources need to be aligned in a network whereby each actor in the network understands its obligations and responsibilities. Such an alignment enables the actors to share common understanding about developing sustainable IT systems so that their individual and joint actions become institutionally shaped meeting the goal of the common network (Kimaro and Nhampossa 2004).

A sustainable IS then needs to meet the needs of the present and be able to keep going over time, when it is institutionalized and the organization is dependent upon it regularly. However, this requires the provision of reliable sources of data and also economic and technical resources. Lack of these resources has contributed to various failures and unsustainable projects (Heeks 2002; Mursu *et. al* 1999; Korpela *et al* 2000). Poor infrastructure, lack of information culture and lack of trained manpower further contribute to these problems of unsustainable systems.

Bisbal *et al* (1999) argued that the sustainability of IT is highly dependent on the system being able to provide reliable and useful information, and the capability of users at all levels to effectively use the system. The absence of participation, capability and motivation of users, coupled with an inflexible system design, makes it difficult for the system to evolve over time and for institutional changes to be incrementally adapted. However, sustainability issues are not only technical (Bjørn-Anderson *et al* 1990) but also concern the ownership and management of human and financial capabilities which rely on people and their needs and actions. Heeks (2002) has identified a checklist of risks that contributed for unsustainable HIS systems in the context of developing countries. Some of these risks are:

- Formal, quantitative information stored outside the human mind is valued less in developing countries;
- The technological infrastructure (telecommunications, networks, electricity) is more limited and/or older in developing countries;
- Work processes are more contingent in developing countries because of the more politicized and inconstant environment;

- Developing countries have a more limited local skills base in a wide range of skills. This includes IS/ICT skills of systems analysis and design, implementation skills, and operation related skills including computer literacy; and
- Developing country organizations are more hierarchical and more centralized.

Sustainability then depends on both the technical features of the technology including its operational simplicity, flexibility, maintainability, robustness and also the availability and capacity of technical, managerial, institutional, intellectual, socio-political, cultural, and physical infrastructure (Kiggundu, 1989). An absence of a socio-technical focus in favor of a technical approach typically contributes to unsustainability of HIS in developing countries.

2.2 Scalability

As Braa et al (2004) point out scalability is a prerequisite- not a luxury- for sustainability of local action. Scalability is not about size as such, it is about facilitating the necessary learning processes as “networks of different organizations or work units that can struggle to learn from each other develop designs that meet specific requirements of local conditions” (Elden and Chisholm 1993). As Sahay and Walsham (2004) pointed out, in practical terms while scale refers to the size or scope of something (for example an information system or a process), scaling concerns the process through which that product or process is taken from one setting and expanded in size and scope within that same setting and/or also incorporated within other settings. In the context of information systems (IS), scale then could refer to the scope of an IS (for example, how many users are served), while scaling could imply the expansion of this system in scope and size (for example, making the system accessible to more users or increasing its functionalities).

Scale is also related to the transfer of technology and routines from one site to another, or from a pilot to a full fledged project. Sahay and Walsham (2004) draw upon an information infrastructure (II) perspective to analyze the challenges of scaling, viewing it not merely as a technical problem, but as a socio-technical one involving a heterogeneous network constituted of technology, people, process, and institutional context. Braa and Hedberg (2002) describe how pilot projects initiated through donor funding fail to address scale and sustainability as interconnected problems. Limited scale projects do often not produce anything useful for managers, who typically need full data coverage from their area of responsibility, and not only for a limited pilot area. As a result, when there is no real useful output produced and after the financial support ends, efforts remain largely unsustainable (Braa and Hedberg, 2002). Problems of scale and scaling are at the heart of the implementation challenge of health information systems in PHCs (Braa et. al., 2004).

In this paper, socio-technical factors that affect the implementation of sustainable and scalable HIS in Ethiopian Public Health Care sector are analyzed. More specifically, concepts of sustainability and scalability are employed in analyzing infrastructure, human resource and HIS related challenges in the process of implementing computer-based HIS in Ethiopian context. The term sustainability is used to analyze socio-technical challenges hindering a system work, in practice, over time in a local setting and in shaping and adapting those systems to adhere to local needs and requirements. The concept of scaling is used to analyze the challenges of making one, working solution spread to other sites (vertically or horizontally) and be successfully adapted there. The challenges of sustainability and scaling are analyzed based on the empirical evidence and experiences of an on-going project being carried out to implement district-based HIS within the Primary Health care Sector in Ethiopia.

3. RESEARCH APPROACH

This study was conducted in Benishangul-Gumuz region of Ethiopia. The case study was part of an action research initiative within the umbrella of HISP research project, which was started in 1994 by researchers from Norway and the Universities of Western Cape and Cape Town. The aim of HISP is to design, develop, implement and sustain health information systems to support the emerging decentralized health administrative structure in various developing countries. The broader agenda of HISP is to enable local control of health information at district and sub-district levels and thus to empower local users to have greater control of their work processes. This study is based on the author's experiences as an action researcher as part of the HISP team in Ethiopia since 2003.

The study has used mainly a participatory action research approach to introduce interventions along with principles of participation involving health workers. As a data collection method, the study uses participant observation and individual interview of informants including: service providers at clinics, health posts, health centers; Program officers (experts and team leaders); and Heads of health Facilities/institutions. A total of 32 semi-structured interviews were conducted (see table 1 for a summary of respondents). In addition to the individual interview, analysis of documents such as: reporting forms, graphs, tally sheets, copies of monthly reports, and registers was also conducted. The issues related to challenges and opportunities in HIS implementation were analyzed through document assessment and exploration of the efforts being made to implement HISP tools and approaches in the region from June to August, 2004.

Table 1. Distribution of Respondents by Academic Level, Position, and Service Years

Academic Level	Service year				Position			
	1-5	6-10	>15	Total	Service Provider	Expert	Team Leader or Head	Total
Junior Nurse (12+1)	13	0	0	13(41%)	13	0	0	13
Health Assistant (12+1½)	0	5	6	11(34%)	9	1	1	11
Senior Nurse (12+2(3))	1	0	4	5(16%)	0	3	2	5
Health officer (12+4(5))	2	0	1	3(9%)	0	0	3	3
Total	16(50%)	5(16%)	11(34%)	32(100%)	22(69%)	4(13%)	6(19%)	32(101%)*

* Percentages may not add up to exactly to 100 due to rounding effect.

4. CASE STUDY

4.1 The Ethiopian Context

This case study is drawn from Ethiopia, a country situated in the horn of Africa. The total area of the country is around 1.1 million square kilometers and it shares borders' with Djibouti, Sudan, Eritrea, Kenya and Somalia. Politically, this country uses a federal

system, comprising of 9 National Regional States (NRS)¹⁰ and two Administrative states¹¹. The regional states as well as the administrative states are further divided into sixty-five zones, five hundred twenty-three 'woredas' and around 10,000 'kebeles'. According to the population projections of the Central Statistical Authority (CSA) based on the 1995 population and housing census, the total population was about 67 million (in 2003 estimates) growing at a rate of 2.7% with more than 85% of its population living in rural areas, making Ethiopia one of the least urbanized countries in the world (HSDP II, 2002).

The public health care system in Ethiopia comprises of the Federal Ministry of Health, Regional Health Bureaus, Zonal Health Departments, and Woreda Health Offices, with their respective health facilities – central referral (specialized) hospitals at the federal level, hospitals at regional, zonal and district levels, and Health Centers, Health Stations, and Health Posts at Woreda levels. The health care system is largely underdeveloped and under resourced and as a result can provide the basic services to only about 60% of the population. Much of the rural population has no access to modern health care, leading to inability of the health care delivery systems to respond both quantitatively and qualitatively to the health needs of the people. The health delivery system is highly centralized; delivered in a fragmented way, relying on vertical programs with limited collaboration between the public and private sectors.

Benishagul Gumuz Regional State is one of the emerging regions of the Federal Democratic Republic of Ethiopia. The Region has 3 zones (Assosa, Metekel, Kamashi) and two special woredas (districts) called Pawi & Maokomo out of a total total of 20 woredas in the region. As per the population projection made by the Central Statistical Authority, the Region's population in 2003 is estimated to be 580,000 out of which over 90% are rural residents. Women of childbearing age make up 24% of the total population while the figure for the under five population is 17%. The Region has high prevalence of communicable disease like malaria, tuberculosis, intestinal parasitosis etc. The infant and under five mortality rate for the region is 97.7/1000 and 197.7/1000 live births respectively (MoH, Health Indicators 2003). The health service coverage is about 55%, and the health service utilization rate is very low. There are two hospitals, seven health centers and 111 health stations & posts. Assosa is the capital of the Region. Around half of the Regions population resides in Assosa Zone and also half of the Regions health facilities are located in this Zone. This case study was conducted in Assosa Zone from June to August 2004. There are seven woredas in the Zone, out of which the study included four. These were: Assosa, Bambasi (45Kms from Assosa), Menge (56Kms), and Sherkole (100Kms) Woredas.

¹⁰ *Tigray, Afar, Amhara, Oromia, Somalia, Benishangul-Gumuz, Southern Nations, Nationalities and Peoples Region (SNNPR), Gambella, and Harari*

¹¹ Addis Ababa city administration and DireDawa council

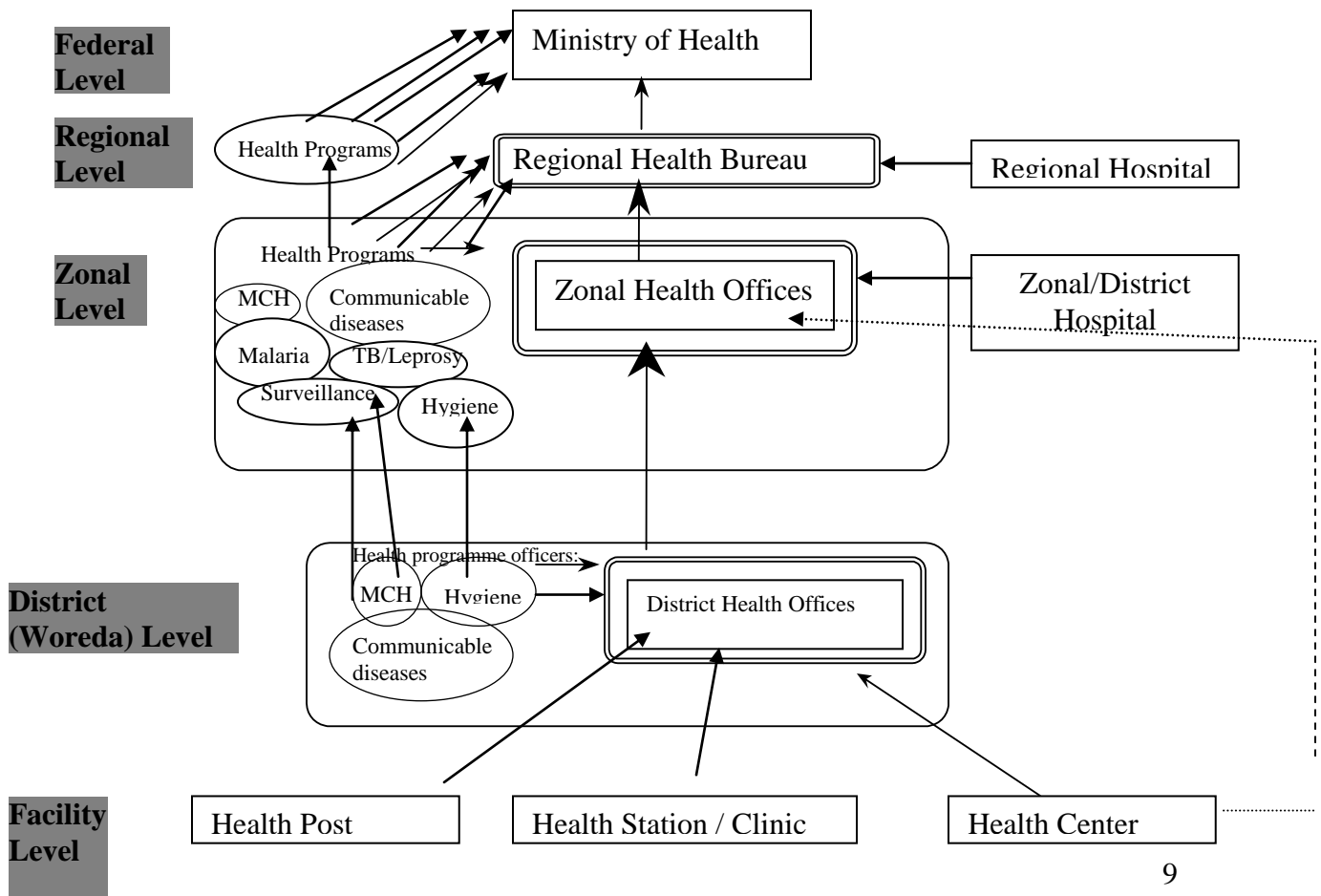
Figure 1: Map of Benishangul-Gumuz Region



4.2 Health System Structure and the Health Information Systems

The health structure is organized into 5 different levels comprising of the Federal Ministry of Health, Regional Health Bureau, Zonal Health Departments, and Woreda Health Offices, with their respective health facilities – central referral (specialized) hospitals at the federal level, hospitals at regional, zonal and district levels, and Health Centers, Health Stations, and Health Posts at Woreda levels (see Figure 2 for schematic sketch of the HIS structure).

Figure 2: Health Information Flow in Benishangul Gumuz Regional State



4.3 Situational Analysis: Case Findings

The case findings are based on the situational analysis on the health structure, flows of health information, existing physical and ICT infrastructure, and availability of skilled manpower. The study was conducted by HISP team members (including the author) for the period of three months from June to August 2004 in Benishangul-Gumuz region.

4.3.1 Infrastructure

The infrastructure situation, both physical and ICT related found to be very poor even compared to other regions in the country. All facilities visited by the researcher except Assosa Hospital, were not equipped with computers. Even at the woreda health offices computers were not available and all data aggregation tasks are performed manually. At Zonal level, from the three zones it was only at Assosa Zone Health Office that computer is available. Even this computer is used by the typist for only secretarial purposes. It is not utilized for health information management (data entry, analysis, report generation etc) activities. Most of the respondents interviewed acknowledged the need for a computer especially for data handling, analysis and report generation.

The region has very poor transport, road, postal and telecommunication infrastructure. For example, except Assosa zone, the other two zones (Metekel and Kanmashi) use radio to communicate with the regional health bureau. It is only in Assosa (the capital of the region) that one can find telecommunication services such as telephone, fax, telex and Internet. Regarding availability of electricity, all health facilities and health offices at woreda and zonal levels (except those in Assosa town) do not have access to electricity. The existing Infrastructure (both physical and computer-based) in the region is so weak. In such situations, introducing computer-based health information systems and making them sustainable and scaling up to other sites will be a challenging task ahead of HISP.

4.3.2 Existing HIS

The situation analysis of the existing HIS in Benishangul-Gumuz region revealed that it is primarily top-down, implying that while planning and implementation of health systems was done at the level of the central ministry of health (MoH), health data is collected using paper form at the local community level and sent up to the region and ministry. Health facilities report directly to woredas (districts). At this level, health data coming from different health units within the district is aggregated and sent to the Zonal health office. At the zonal level, data collected from the different districts within the zone will be summarized and reported to the region. The region will then aggregate and make some analysis on the data collected from all the zones within the region and report it to the national level (MoH) for overall nationwide data integration and analysis.

A large part of the data collected by health workers at facility level, in some cases almost all of it, was transmitted to the higher level with out being analyzed and used locally. Feedback from MoH and regional health bureau to the local levels is limited. At all the levels visited (facility level, woreda and zonal health office level), all the respondents said that they have never received feed back from the higher level to which they send reports on monthly basis. The multiplicity of health programs and their lack of integration

constitute to uncoordinated data flows and reporting routines, and also to a major impediment on managerial activities.

All respondents interviewed reported the use of different forms for the various health programs including: MCH (includes FP, CDD, ARI, GM, Delivery, ANC), EPI, Environmental sanitation/hygiene, Health Education, HIV/AIDS, STI, TB/Leprosy, IDSR (surveillance), Malaria, Morbidity, Laboratory. Most of the respondents complained about excessiveness of data and lack of clarity on reporting forms.

A majority of health workers work time is spent on data collection (filling registers) and reporting to higher levels, which when conceived with their health provision work, resulted in a very heavy overall workload. Average time required for the service providers to fill registers etc. was 4:30 hours of daily work. The range identified was 1-8 hours. Health workers, especially those serving large population segments worked often more than 8 hours a day. Average time taken for preparing the monthly report i.e. summing up and filling the forms was 1.5 days (range from 3 hours to 4 days) for the service providers, 2.5 days (range 1-3 days) for the experts and 2.3 days (range 1-5 days) for the team leaders or heads.

With respect to the importance of the data they collected to their everyday work, most respondents believed that data collection was important. But, they consider the data as irrelevant for their everyday work practices. The respondents saw data collection as a task conducted just for reporting to the higher level, and they collected data because they were expected to do so.

Respondents indicated that reports do not reach to higher levels at the right time to make appropriate action and decision. The main reasons cited for this delay are: lack of transportation, shortage of manpower, and lack of reporting forms.

The challenges on the existing HIS structure and flows of health information system can be summarized as follows:

- The existing HIS structure is primarily top-down with no analysis and use of information locally. Reporting to higher levels is top priority.
- In the existing health system, health data is not maintained in a systematic way on health facility basis. The existing HIS is designed to support higher levels in the evaluation of vertical programs which hinders local participation and local use of information at facility, woreda, and zonal levels. It is organized based on the needs of the vertical health programs at the central level and not on the needs of health units at the local level. The system, therefore, doesn't allow local analysis and use of data and information for local action and decision.
- The vertical structure of the reporting system and the way data is aggregated at Woreda (district) level makes it difficult to keep, maintain and analyze data to support district management. Inadequate organization and management (i.e., vertical programs and centralized planning) is the major underlying factor contributing to the inadequate distribution of services and mediocre performance of health services to the region.
- The feedback routines from Regional health bureau to Zones and then to woredas and from woredas to health facility are poor. This resulted to delayed reporting and incomplete data from the lower level.

4.3.3 Human Resource

Respondents indicated that they lack the necessary skills for data handling and management. The lack of skills and knowledge for data handling was due to lack of training and support in this regard. All the health workers interviewed reported that they had never been given any training on health information and they had not been provided with any guidelines or protocols on data collection, processing, analysis and its transmission. For example, asked about their knowledge of health indicators, ninety four percent of the respondents didn't know the meaning of 'indicators'. It was only two health workers (6%) at the zonal health office that reported they know what the term 'indicators' meant. Asked about their computer literacy, none of the respondents have replied as they have computer literacy. Most of them even don't have touched computers in their lifetime. Implementing computer-based HIS for such users who doesn't have any know how about the technology and ensuring sustainability of that system is a challenge in HISP initiatives in the region. Scaling of such systems from the pilot sites to other zones and woredas is also a challenging task.

5. CASE ANALYSIS AND DISCUSSION: THE CHALLENGES AND OPPORTUNITIES FOR HISP INITIATIVE

The case analysis is based on the situational analysis and experiences of an on-going project being undertaken to implement computer-based health information system in Benishangul-Gumuz region. The case analysis addresses the implications of the findings on the challenges of implementing district-based HIS in the region. More specifically, challenges of sustainability and scalability in implementing computer-based HIS are explicitly discussed. Besides, issues related to how HISP is dealing to tackle those challenges and the implication of those challenges in implementing sustainable and scalable HIS in the region are discussed. A variety of constraints and challenges have been identified ranging from a vertical and top-down health structure, inadequate infrastructure and manpower shortages, to a culture that does not yet value the efficient use of information. Questions related to how the existing HISP approaches and efforts are adapted to existing HIS structures, how local interventions are made sustainable through institutionalization, and how local interventions are scaled to other sites (Zones and woredas in the region or to other regions in the country) are central challenges of implementing district-based HIS in the region. The HISP project aims to create local capacity for data handling and processing in order to support informed decision processes at the national, intermediate, and peripheral levels

HISP-Ethiopia was initially introduced in Ethiopia to address the existing problems of HIS in collecting, analyzing, interpreting, and reporting health data and to investigate and explore the potential that ICTs can provide to improve the way people work by increasing efficiency, quality of data and access to stored information and to reduce the overall costs of overall health care delivery system. The project is engaged at all levels and aspects to enable effective implementation of various data collection standards, their storage, processing, analysis and use.

In Ethiopia, HISP aims to design, develop and implement sustainable and scalable HIS at the woreda (district), zonal and regional levels. Through the local experience, HISP-Ethiopia will also contribute to the broader development of the HISP global network.

HISP seeks to introduce computers at the district (woreda) levels as contrasted to the existing focus of computerization at regional and national levels. By placing computers at the district and through training of district staff, HISP seeks to redress the current imbalance in focus and encourage the local analysis and use of information to support health care in peripheral and remote areas.

Some of the tasks performed so far by HISP in Benishangul-Gumuz region are:

Situational analysis on existing HIS structure, flow of health information, infrastructure and identifying the information needs of health workers and managers;

The formation of HIS review teams comprising of health workers, managers (from woreda, Zone and regional offices) and IS professionals from HISP to ensure partnership and participation among health workers and IS professionals;

Development of essential data sets and standards for primary health care data for the region;

DHIS database implementation and customization that supports the storage, analysis and dissemination of health data at different levels. The implementation of DHIS software was undertaken at the regional health bureau and Assosa zone health department in Assosa town. Due to lack of computers and other facilities the software is not yet set up at Woreda levels in the region.

Ensure partnership and collaboration among HISP teams across the different pilot regions in Ethiopia. This includes exchange of software, manpower, training tools and materials, essential data sets and standards...etc.

The following sub-sections present analysis of the different socio-technical challenges encountered in the process of implementing computer-based HIS in the region and their implications on making those systems sustainable and scalable. HISP approaches and strategies in dealing with those challenges and how to address the issues of sustainability and scalability of HIS in the region are discussed.

5.1 Human resource Challenges

Implementation and use of HIS in developing countries is often unsustainable due to lack of appropriate human resources to operate the system and to continue its development over time. These challenges are also evident in Benishangul-Gumuz region, including lack of trained and qualified manpower, inadequate computer literacy, heavy workload of health personnel, and conflict between providing care and administration of routine health data. According to Heeks (2002), one of the factors that contributes for unsustainable HIS in developing countries is that developing countries have a more limited local skills base in a wide range of skills. This includes IS/ICT skills of systems analysis and design, implementation skills, and operation related skills including computer literacy. To deal with human resource related challenge and to ensure the sustainability of the system in the region, HISP is trying to address these problems in different ways. Some of the approaches used by HISP to deal with manpower problems are presented as follows:

Hiring of full time trainer and facilitator: In dealing with the problem of computer literacy among health workers and managers, HISP has employed a full-time facilitator in all the pilot regions. Each regional facilitator is responsible in trouble shooting and giving training to health workers and managers about the basics of computer hardware, software, operating systems and basic Ms-office application packages (Ms-word, Ms-Excel, Ms-Access) and of DHIS software. The facilitator is also responsible to customize DHIS software to fit to local needs and requirements.

Involving medical doctors in the implementation program: In order to create close partnership and to ensure sustainability of the system being implemented, HISP promotes the involvement of medical doctors along with IS professionals in the implementation of DHIS software. This will help both parties to assist each other and gives opportunity for medical doctors to improve their IT skills and IS professionals to improve their knowledge in the public health domain.

Linking implementation with education and research: In the Ethiopian context, there are doctoral and master students from Addis Ababa University, Department of Informatics who are studying at the University of Oslo (Department of Informatics) and who are writing their thesis on problems particularly relevant to the health departments at different regions of the country. Currently, the students are closely working with health workers and managers at different levels and conduct software customization, implementation of DHIS software, user training on the basic IT skills and the software...etc. This arrangement contributes to ensure sustainability of the district-based health information system being implemented by HISP by creating partnership and collaboration among the regional health departments, the informatics department and HISP.

5.2 Infrastructure Challenges

As Avgerou and Walsham (2000) indicated, key impediments to developing scalable systems arise from resource constraints and lack of political will. Although there is a good political will in transforming and improving the existing paper-based health information system in Benishangul-Gumuz region, lack of resources and poor infrastructure are the major impediments for the implementation of a bottom-up district-based health information system using HISP approaches and tools. As Heeks (2002) pointed out lack of technological infrastructure (telecommunications, networks, and electricity) is one factor that contributes for unsustainable systems in developing countries. In Benishangul-Gumuz region, the existing Infrastructure (both physical and technological) in the region is so weak. This situation has a negative impact in making the new system sustainable and work, in practice, over time, in a local setting.

The primary challenges in relation to infrastructure of the region are: lack of computers electricity and telecommunication infrastructure; non existence of roads and lack of vehicles at woreda and zonal health offices; and poor office and work facilities. Let alone the districts and health facilities, two of the three zones (Metekel and Kemashi) in the region are isolated from the main road and can't be reached by vehicles during rainy seasons. This isolation has seriously affected all aspects of socio-economic development processes including provision of improved health care to the remote and isolated communities. The existing poor technical and physical infrastructure in the region (particularly lack of electricity and public transport in the two zones of the region) has a

negative impact in ensuring sustainability of the new system being implemented in the region and in scaling-up software, experiences and knowledge acquired in the pilot zone to other districts and zones within the region.

Although fully addressing all the specified infrastructure related problems is beyond the capacity of HISP, the following approaches are used to tackle infrastructure related problems in the region:

HISP has introduced free open source code software (DHIS) which is developed using MS-Access database system. The software is easy to use and can be implemented at lower facility and district levels. Besides it doesn't require computers with high memory capacity and processing speed. Attempts are being made to acquire some used computers from some international organizations (WHO, UNICEF, USAID) working locally to alleviate the problem of computers in the region.

Data entry can be done over a few days once in a month when electricity is there.

By consolidating and integrating the data forms the number of reports to be generated could be reduced. This can help health workers to compile and send the reports on time to higher levels using the existing means of communication.

5.3 Dealing with the existing HIS structure

The major challenges of the existing HIS in the region are: vertical structure and top-down approach; lack of integration among different programs; lack of feedback information, inconsistency of items and lack of clarity in reporting formats; lack of guidelines on health information collection, analysis and reporting; delayed reporting; and reporting of incomplete data. Another important challenge in implementing sustainable and scalable HIS in the region is the existing culture of information, which doesn't value information as important resource for action and decision making by health workers at different levels. These challenges have a negative impact in making the new systems sustainable and in scaling experiences and knowledge to other sites in the region and to other regions in the country. The HISP approach and philosophy of user participation and involvement in all phases of systems development would solve most of the existing HIS problems of the region. As Braa et al (2004) pointed out; one of the important issues that contributes for sustainability of IS is shaping and adapting the systems to a given context, cultivating local learning process and institutionalizing routines of use that persist over time. In dealing with the existing HIS related challenges in the region, the following tasks are being undertaken by HISP:

Bottom-up, incremental and participatory approach: HISP follows flexible, incremental, and scalable approaches to systems development. Such an approach allows for user participation, learning and institutional capacity to be developed through the process of developing, implementing and using the systems. HISP's bottom-up and incremental approach empowers local users to use information for local action and decision making. For example, the process of developing the Essential Data Sets (ESD) for Benishangul-Gumuz region was conducted by using participatory approaches and involving health workers and managers at different levels of the hierarchy. This approach contributes to ensure the sustainability of the new system by involving all stakeholders at different levels in the process of transforming the old system and introducing a new

system. Scaling of whatever knowledge and experience obtained in the pilot sites will be also easier.

Emphasizing the importance of local use of information: HISP builds an information culture among health workers with new understandings and perceptions towards information, and social values of behavior related to collection, reporting and use of information. For example a two days workshop to create awareness on the importance of health information was given for health workers and managers at different levels. As Heeks (2002) indicated, limited local skills base in a wide range of skills contributes to failure and unsustainable IS in developing countries. Thus, HISP's approach of giving trainings and creating awareness on information use behavior through workshops and conferences is crucial to change the attitude and knowledge of health workers and managers towards health information and to make the new system more sustainable in the region.

Developing essential data sets and standards: HISP addresses the problem of integration and standardization among vertical programs through bottom-up processes of standardization and IS development that emphasizes local control of information and computing resources. The development of standardized EDS for Benishangul-Gumuz region using a bottom-up process addresses the problems of inconsistency and integration among the different health programs and would contribute in the development of sustainable health information system in the region. The ESD developed for the region could also be scaled up to other pilot regions in the country.

Spread of tools, expertise, experiences and knowledge across regions: HISP believes in both vertical (with in the region) and horizontal (across the regions) spread of ideas, tools, artifacts, experiences and knowledge across different levels in the same region and between regions. For example, the EDS developed for Addis has been shared among different HISP pilot regions as a baseline document.

CONCLUSION

In this paper, I have discussed the challenges of scalability and sustainability more generally with respect to HIS implementation in developing countries context. These challenges also exist in Benishangul-Gumuz region and have been revealed through my situation analysis. I have distinguished some of the challenges and opportunities related to an ongoing HISP initiative in the Ethiopian context. Some of the major challenges that hinder the implementation of district-based health information system are: vertical and top-down health structure, inadequate infrastructure, lack of appropriate manpower, and a culture that does not yet value the efficient use of information. These challenges affect the scalability and sustainability of the HIS being implemented in the region. In dealing with these challenges, HISP has introduced different approaches and strategies. Challenges of sustainability is being tackled by developing systems using bottom-up, incremental and participatory approaches, user training, by establishing partnership among different stakeholders (such as health workers, managers, researchers, and IT professionals), by emphasizing the importance of local use of information, and by developing essential data sets and standard reports forms. The challenges of scale are tackled by linking HIS implementation with education and research, allowing different standards at different levels with in the same region and across regions, and by allowing the spread of ideas, tools, methods, experiences and knowledge across different nodes. In the analysis of sustainable and scalable interventions, it was noted that getting local involvement of health workers and managers in the development and implementation process and self-sufficient learning processes to share experiences across different regions are crucial factors for sustainability.

REFERENCES

- Amonoo-Lartson, et al (1984). District Health Care, Challenges for Planning, Organization and Evaluation in Developing Countries. London: Macmillan Press.
- Avgeru, C. and Walsham, G. (2000). Information Technology in context: Studies from the perspective of Developing Countries, Ashgate.
- Bisbal, J.; Lawless, D.; Grimson, B.Wu and jane. (1999). Legacy Information systems: Issues and directions. *IEEE software*, September/October 1999, 103-111.
- Bjørn-Anderson, N.; Mohan L.; and belardo, S. (1990). A contingency approach to managing information technology in developing nations: Benefits from lessons learned in developed nations, pp. 15-22. In: S.C. Bhatnager, and N. Bjørn-Anderson, (eds), Information technology in developing countries. North-Holand: Elsevier Science publishers B.V and IFIP.
- Braa, J. and Hedberg, C. (2002). The struggle for district-based health information systems in South Africa. *The Information Society*, 18(2): 113-127.
- Braa, J., Sahay, S., Montero, E. (2004). Networks of action: Sustainable health information systems across developing countries. *MIS Quarterly*, 28: 337-362.
- Elden, M and Chisholm, R. F. (1993). Emerging varieties of action research: introduction to the special issue. *Human Relations*, 46(2): 121-142.
- Federal Ministry of Health (2002/03). Health and Health Related Indicators. Addis Ababa, Ethiopia.
- Federal Ministry of Health. (2002). Health Sector Development Program II. Addis Ababa, Ethiopia.
- Heeks, R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvizations. *The Information society* 18: 101-102.
- Kiggundu, M. N. (1989). Managing Organizations in Developing Countries: An Operational and Strategic Approach. West Hartford, Connecticut: Kumarian Press.
- Kimaroo, Honest C., and Nhampossa, Jose L. (2004). The Challenges of Sustainability of Health Information Systems in Developing Countries: Comparative Case Studies of Mozambique and Tanzania. In: LEINO; T., Saarienen, T. & Klein, S. (eds.) Proceedings of the 12th European Confrence on Information Systems. Turku, Finland, ECIS_ The European IS Profession in the Global Networking Environmnt,
- Korpela, M., Soriyan, H.A., Olufokumbi, K.C, Murusu, A. (2000). Made-in Nigeria systems development methodologies: An action research project in the health sector. In C. Avgerou and G. Walsham (eds), Information Technology in Context: Studies from the perspective of developing countries, Aldersho publications, Ashgate, pp.134-152.
- Korpela, M., Soriyan, H.A., Olufokunbi K.C., Onayade, A.A., Davies-Adetugbo, A. and Adesanmi, D. (1998) Community participation in health informatics in Africa: and experiment in tripartite partnership in Ile-Lfe, Nigeria. *Computer Supported Cooperative Work* 7 (3-4): 341-361.
- Lippeveld, T. et al (2000). Design and Implementation of Health Information Systems: WHO.
- Misund, G., and Høiberg, J. (2003). Sustainable Information Technology for Global Sustainability, Digital Earth - Information Resources for Global Sustainability Symposium 21-25.9 2003, Brno, Czech Republic. Accessed from URL: http://www.ia.hiof.no/~gunnarmi/omd/dig_earth_03/, [Accessed July 2004]
- Murusu, A., Soriyan, H.A., Olufokunbi, K.C., and korpela, M.(1999). Towards successful ISD in developing countries: First results from a Nigeria risk study using the Delphi mMethod, Proceedings of IRIS 22.
- Reynolds J. and Stinson, W. (1993), sustainability analysis, Primary Health Care Management Advancement Programme, Aga Khan Foundation, Bangkok.
- Sahay and Walsham. (2004). Scaling of Health Information Systems in India: Challenges and Approaches. *Information Technology for Development*, 12(3): 185-200.

APPENDIXES II

Shaw, V., Mengiste, S. A. and Braa, J. (2007). Scaling Health Information Systems in Nigeria and ethiopia- Considering the Options. In: Silva, L.; Westrup, C. and Reinhard, N. (eds.). Proceedings of the IFIP W.G 9.4 on Social Implications of Computers in developing Countries. Sao Paulo, Brazil.

SCALING OF HEALTH INFORMATION SYSTEMS IN NIGERIA AND ETHIOPIA - CONSIDERING THE OPTIONS

Shaw, V., Mengiste, S. A. and Braa, J. (2007).

IFIP WG 9.4 Conference. Social Implications of Computers in developing Countries. May 27-29, 2007, Sao paulo, Brazil.

ABSTRACT

This paper addresses the IFIP 9.4 conference theme for papers that take stock of the development of ICT in the health sector, and in particular how infrastructure and human resource factors influence the implementation of e-development initiatives. Using case studies from the Health Information Systems Programme in Nigeria and Ethiopia, the interdependencies between three spheres are identified as being important in scaling health information systems. The three spheres that are explored are the volume of data collected, human resource factors and access to technology. We draw on concepts from mindful innovation with technology to illustrate that a cultivation approach is appropriate to bringing about change. We suggest that a balance needs to be achieved between the three spheres if scaling initiatives are to succeed, and identify a number of factors that can be used to achieve and maintain the balance. Three flexible standards are identified as being critical strategies to global health information scaling initiatives, namely an essential data set, a scalable process of information systems collection and collation consisting of gateways between paper based systems and hardware and software which can be interfaced with one another, and a cultivation approach.

Keywords: Health information systems, developing countries, scaling, district health information software, health information systems program.

1. INTRODUCTION

The scaling of information systems (IS) is a field which has been explored for a number of years in relation to the internet (Monteiro, 1998, 2000) and with respect to the effects of globalization (Rolland & Monteiro, 2002). In the health sector, scaling of health information systems (HIS) is a “pre-requisite and not just a luxury” because in order to make sense of for example immunization coverage data, data from all facilities and services in a region, province, or country are needed (Braa, Monteiro, & Sahay, 2004, p. 341). Yet, despite this imperative for sustainable information systems (IS), this field of study has not been explored in depth. In this paper, we explore the choice of solutions in scaling HIS in one region from each of Ethiopia and Nigeria, and draw lessons for scaling of IS in general. The selection of these countries is purposeful – they represent the two most populous states in Africa, and together represent almost 30% of the sub-Saharan population. Scaling HIS in these contexts is about scaling of large scale systems so as to achieve an appropriate coverage of the population to make meaningful sense of the data. We address the request in the call for papers that papers take stock of the development of ICT in the health sector, and in particular how the infrastructure and human resource factors influence the implementation of e-development initiatives.

Although scaling of HIS has been alluded to in three papers related to the Health Information Systems Programme (HISP) network (Braa, Hanseth, Heywood, Mohammed, & Shaw, Forthcoming, Braa, Monteiro, & Sahay, 2004, Sahay & Walsham, 2005), little detail exists about the choices when implementing (and scaling) large scale HIS. Sahay and Walsham (2005) describe the tension between globalization and localization, and the need to consider which parts of a system are scaleable and which require local customization. This challenge is central to the scaling of large HIS in complex environments, and is the focus of our research. We address this by exploring the role that human resources and technological components play in influencing the type and volume of data that can be collected and processed as HIS are scaled.

IS should be designed in a manner that allows them to be scaled through an evolutionary process (Braa et al., Forthcoming). In this paper we build on the concept of cultivation of IS by drawing on the concept of “mindful innovation of IT” (Swanson & Ramiller, 2004). Mindfulness, is characterized by an openness to novelty, alertness to distinction, sensitivity to different contexts, implicit or explicit awareness of multiple perspectives, and orientation in the present (Weick, Sutcliffe, & Obstfeld, 1999). We suggest that for successful scaling of HIS, mindfulness is required to balance the available human resources, access to technology and the type and volume of data collected by the HIS. By paying attention to these spheres and their interdependencies, rational choices can be made regarding which aspects of the IS can be unproblematically scaled and which require specific attention and local adaptation.

This paper proceeds as follows. The literature review addresses the scaling of HIS, and the use of mindfulness as an appropriate strategy for cultivation and scaling of HIS in complex organizations. In section three the methodology is presented. Section four describes the case of HIS development in Jigawa State of Nigeria and Amhara Region of Ethiopia. The discussion section follows and lastly concluding remarks and acknowledgements are presented.

2. THEORETICAL CONSIDERATIONS

2.1. Scaling of Health Information Systems:


The scaling of information systems can be viewed along two axes (Table 1). The horizontal axis reflects the replication of processes across geographic spaces, or across new functional areas. (Braa et al., Forthcoming). Scaling along the vertical axis occurs through increasing the “depth” of penetration of the health system, or increasing the technological sophistication of the IS. Sahay & Walsham (2005) point out that scaling is not only about the technical aspects, but also about the people and processes, and escalating complexity. Not only does scaling require the implementing team to be cognizant of the needs that should be addressed by the scaling process – technical as well as human

resource needs, but they also need to be aware that as scaling occurs, complexity (linked to “institutional practices (and) politics” (ibid, p. 51) is likely to increase. Building on this understanding, a third dimension to scaling IS is presented as the extent to which the system is rooted in people and work practices, and which describes how well the system is working (Table 1).

As IS are scaled horizontally or vertically, heterogeneity is likely to increase (Sahay & Walsham, 2005). Flexible systems are required to accommodate differences and changes (Braa, Hanseth, Heywood, Mohammed, & Shaw, Forthcoming). Flexibility is achieved in different ways. Along the horizontal axis, common data standards are used to provide uniformity across the geographic scope – for example the “essential dataset” (EDS) (Braa & Hedberg, 2002). The EDS is “a set of the most important data elements, selected from all primary health care programs, that should be reported by health service providers on a routine basis” (Shaw, 2005 p.632). Using the concept of the “hierarchy of information needs”, the local users can expand the essential dataset to address their specific needs, while still reporting on the essential data required at the central level. In this way a dynamic balance is achieved between the local and the global information needs (Jacucci, Shaw, & Braa, Forthcoming; Rolland & Monteiro, 2002; Sahay & Walsham, 2005). The data standard is thus a “flexible standard” that allows “integrated independence” – the ability to experiment and develop local indicators while maintaining the data standard (Braa et al., Forthcoming).

Along the vertical axis, the challenge is to seamlessly integrate the flow of information between incompatible systems represented by the geographic periphery, and different technological systems, while also accommodating the need for change. To do this, gateways are used. Gateways are of the following types: paper-to-paper, paper-to-computer, and computer-to-computer, and will typically consist of simple software solutions and/or procedures. Utilizing gateways in various combinations accommodates flexibility and heterogeneity in that sub-systems of the IS can be changed or replaced without affecting the flow of information through the whole system. As access to technology in the periphery improves, computers can easily replace paper-based systems without negatively affecting the whole. Gateways provide flexibility as they are replaced and adjusted as sub-systems change.

Despite these insights, there is a need for practical guidance on strategies to effect scaling of IS. The cultivation approach is presented in the next section as an approach that is sensitive to the ever changing dynamics of the health sector environment.

Axis	Horizontal Axis (Dimension 1)		Vertical Axis (Dimension 2)	
Aspect of the health IS	Data standards - what data?	Geographic scope	Depth of penetration of the health system hierarchy	Technology standards (sophistication of the technical components)
Explanation	The message. From whom does the message come? Both geographic scope and spread across different programme areas.		How is the message communicated between levels, or from one system to another?	
 Increasing sophistication	Essential data set	One facility	State/Region	Paper based systems
	Pharmaceutical data	Additional facilities till whole state included.	Zone/Gunduma	Stand alone computer
	Notifiable diseases	Additional states till whole country included.	LGA/District	Networked computers
	Other types of data, e.g. survey data	One country	Health clinic and hospital Community Individual patient record	Internet based IS
Dimension 3: The extent to which the system is “rooted” in the social system, information use & ownership – this drives the imperative to scale HIS vertically and horizontally				
Table 1: Understanding the different aspects of the Health Information System				

2.2. Scaling HIS as a cultivation process:

The study of complexity within health organizations suggests that adaptability is an important characteristic (Begun, Zimmerman, & Dooley, 2003). It recognizes the ability of organizations to accommodate changes in their environment through a process of adaptation. This can be seen as a survival mechanism, and explains how organizations gradually adopt new ways of working as for instance technology changes. Change that occurs through incremental steps is appropriate in organizations because it accommodates change with minimal disruption to the existing processes (Bergqvist, Dahlberg, & Ljungberg, 2002).

The distinction between cultivation and construction dates back to Aristotle. For example, cultivation is seen as helping nature produce more perfectly things she could produce of her own accord, while construction entails reforming nature to produce things not found (Mitcham, 1994). “Another version of this distinction might contrast technological actions that are in some way in harmony with nature with those that are not” (ibid, pp 211). By “replacing” nature in this quote with a social systems perspective on IS (e.g. Braa & Hedberg, 2002), we might say that cultivation as a strategy in this context will entail being in harmony with the social systems and building on the resources already there, although in a “progressive” bottom-up perspective of change. Not only has cultivation been used to describe an approach to organizational change in which people are central to the information system (Bergqvist, Dahlberg, & Ljungberg, 2002), but it has also been used as an appropriate strategy for effecting change in information infrastructures (Aanestad 2002; Hanseth 2002). However, in considering the scaling of HIS in India, the bottom-up cultivation approach that was initially adopted needed to be complemented by a top-down strategy that provided legitimacy for further scaling (Sahay

& Walsham, 2005), and similarly in South Africa (Braa, et al, Forthcoming). Yet, even when the systems are officially accepted, access to resources do not necessarily improve, and the further scaling of information systems has to occur within the existing resource constraints. This is often the dilemma of those involved in the implementation (and scaling) of HIS – how to accommodate the increasing demands (the “all or nothing” imperative (Braa, Monteiro, & Sahay, 2004, p. 340) or face the risk of the system being replaced by yet another alternative system that is perceived to be more useful.

Weick, et al (1999) has used the concept of mindful innovation to describe the adoption of IT in high reliability organizations (HRO’s) like naval aircraft carriers and nuclear power stations. These organizations utilize “complex processes to manage complex technology” (Weick, et al, 1999, p. 83) because the consequences of failure in an environment that is vulnerable and subject to unexpected changes are devastating. Organizations wishing to survive in these conditions must be able to adapt to unexpected changes. Adaptive responses to the unexpected requires mindfulness, as characterized by a pre-occupation with failure, a reluctance to simplify interpretations, a sensitivity to operations, a commitment to resilience and a reliance on expertise over formal authority (Swanson & Ramiller, 2004). Mindfulness enhances the cultivation approach for scaling HIS by suggesting a number of specific characteristics that should be incorporated in the approach to scaling HIS. Three of these are summarized in Table 2. Using empirical data from Ethiopia and Nigeria, the importance of paying careful attention to these characteristics, especially as they relate to the complex interactions between the skills and capacity of people in utilizing technology to communicate and process health information, is demonstrated.

Characteristic	Brief description and application to HIS
Preoccupation with the possibility of failure	Through constantly being aware that IT projects are prone to failure, a proactive awareness of opportunities that can be harnessed to support the successful scaling should be encouraged. (we use empirical data to demonstrate how an “awareness of the possibility of failure” can be used to guide which aspects of the IS can be unproblematically scaled and which require specific attention and local adaptation.
Commitment to resilience	It is impossible to identify every possibility that might arise during scaling of HIS – therefore improvisation will be required to complement plans, adaptation will be necessary, and effectiveness required rather than efficiency.
Sensitivity to operations	small faults can cause major consequences if not addressed. This is the processes of local customization to ensure that systems and procedures are locally appropriate. It also entails responding to seemingly small problems before they create larger problems.

Table 2: Brief description of some characteristics of mindful innovation

3. METHODOLOGY:

The empirical basis for this study is derived from the large scale and on-going HISP action research project which is engaged in the design, development and implementation of HIS in many developing countries including Ethiopia (Braa et al., 2004) and Nigeria. We have purposefully selected a single state/region from each of these countries based on the in-depth knowledge by the authors, and because the scaling of HIS in the two regions present similarities and differences which allow interesting comparisons to be presented.

The principle author’s involvement in Nigeria began in 2003 at the initiation of the 5 year, Nigerian Partnerships for Transforming Health Services (PATHS) project funded through the British Department for International Development (DFID). The project is active in 5 of the 37 Nigerian states.

He has in the last year spent about 90 days in Nigeria in these two states, supporting the improvement, and scaling of primary health care IS. The second and third authors have been involved in IS development in Ethiopia since 2003 when HISP activities began through a collaboration with Addis Ababa University and the University of Oslo. The second author, an Ethiopian national and member of the HISP-Ethiopia team, has provided support to the RHB's, and in particular to the Amhara Region.

Data sources accessed during project activities includes on-site observations, notes made in a diary kept specifically for the purpose, photographs, documents, tools and project reports. The research data has been analyzed in the interpretivist research tradition as described by (Walsham, 1993).

4. CASE DESCRIPTION:

In the case descriptions we initially provide a background perspective on the development of the state and the health system, and then describe particular aspects related to the development of the HIS. In each case we have tried to detail aspects related to the three spheres under consideration, namely the data collected, the technology, and the staffing.



4.1. Background

Jigawa is a new state, having been created out of the Kano state in northern Nigeria in 1991 (Table 3). It is the sixth Nigerian state to introduce Sharia Law. The state is divided into 27 local government authorities (LGA's), and state and local government councilors are democratically elected. As in the case of Amhara Regional State, considerable effort is being directed towards decentralization of services.

The two case study sites have remarkably similar indices (Table 3). Both have poorly developed infrastructure, and (in terms roads, electricity, telecommunications), although in recent months access to electricity and telephones has increased remarkably in the periphery of Amhara Region State. Human capacity is poor in both states, and immense geographical distance (e.g. one of the zones is located at a distance of more than 700 km from the regional capital) hinders communication and supervision.

Health services are poorly developed in both states. In Jigawa, the maternal mortality rate is estimated to be 1,700/100,000 live births in Northern Nigeria (Kano State Economic Planning Committee, 2004; Shiffman, Okonofua, & Ved, 2006) – several times higher than that for Nigeria. It is estimated that in Amhara Regional State, basic services are provided to only about 60% of the population (Ministry of Health, Ethiopia, 2005).

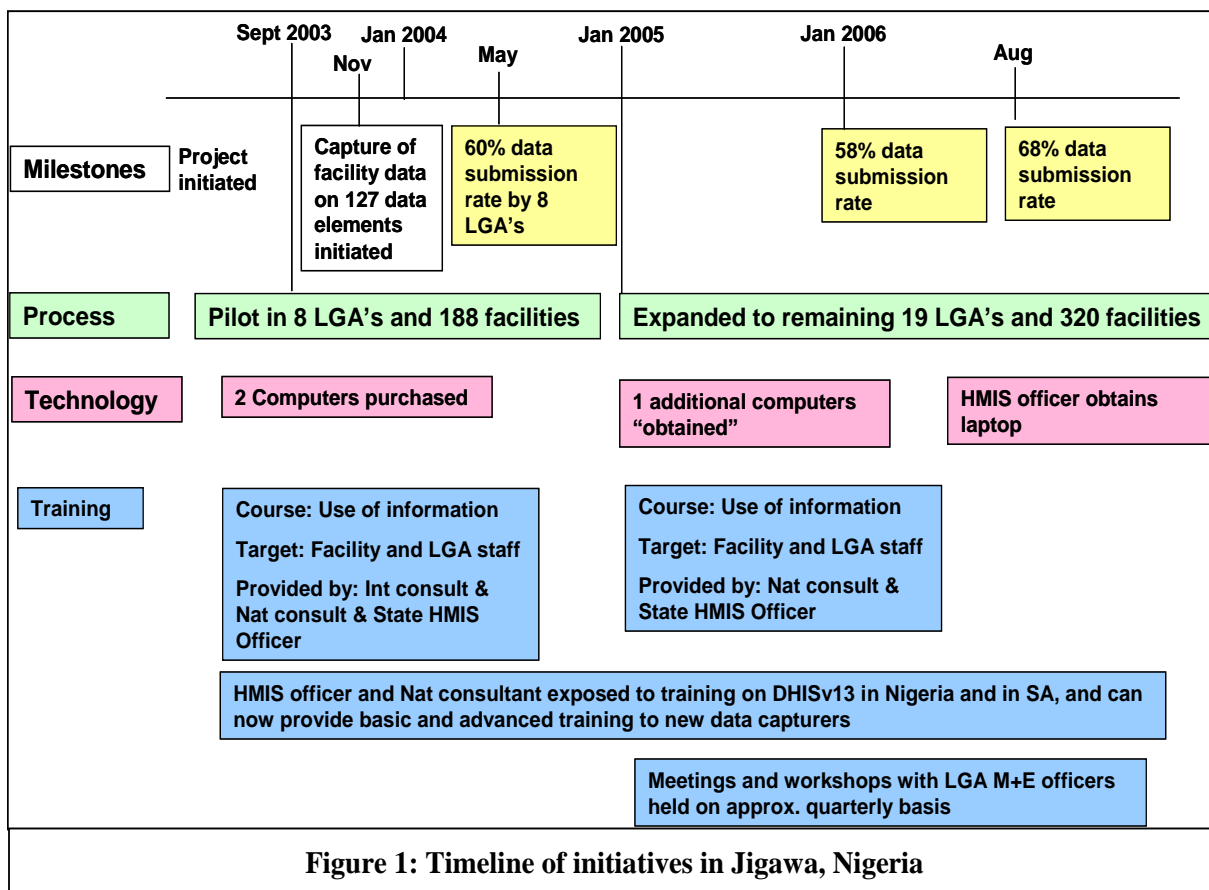
A key difference between the two case study sites is that in Amhara Region, access to ICT has increased dramatically in the last few months as part of a governmental initiative, while in Jigawa outside of the main centers ICT infrastructure is extremely weak. However, in Jigawa the staffing levels are higher (even if skills are low), while in Amhara the staffing levels are extremely poor. These differences have required different approaches to the development of the HIS, as is discussed below.

Jigawa Statistics ¹²		Amhara Statistics	
			
23,154 km ²	Surface Area	161,828.4 km ²	
4,9M vs 131,5M for Nigeria	Population 2005 est	19M vs. 74M for Ethiopia	
49%	Population under age of 15 years	44%	
22% for women and 51% for men	Literacy Rate (2002)	22% for women and 46% for men	
US\$290 vs. \$1,188 Nigeria average	Gross per Capita Income (2001)	US\$100 vs. \$120 Ethiopian average	
Table 3: Selected Statistics for Jigawa State, Nigeria and Amhara Regional State, Ethiopia			

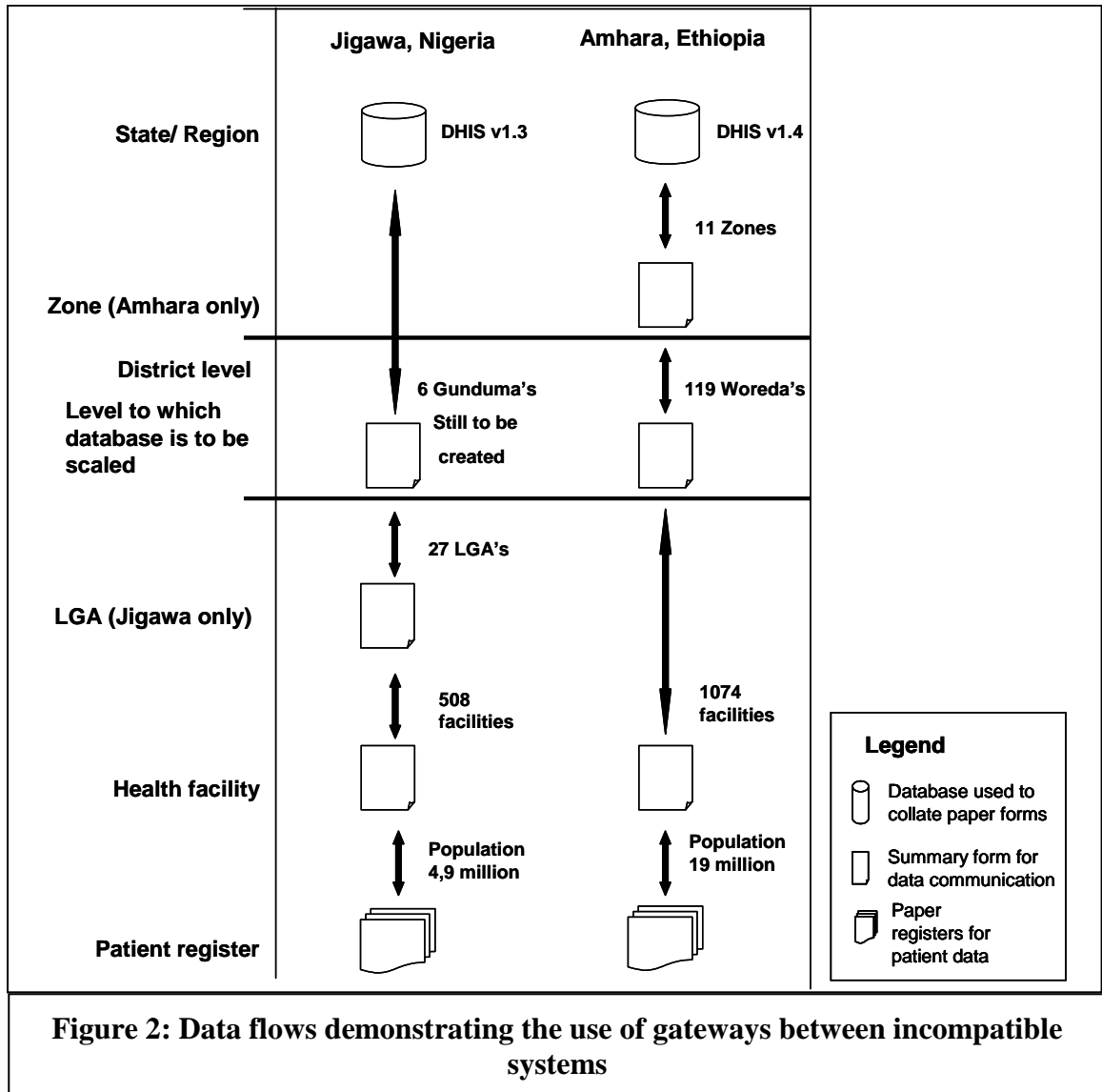
4.2. Information systems development in Jigawa – limiting the dataset

In Nigeria, the PATHS project has been supporting health systems development through targeted program support, particularly to maternal and child health programs, malaria and tuberculosis and sexually transmitted infections. Supporting the HIS has been integral to these initiatives (Figure 1). HMIS development occurred in Jigawa and 2 other states as a parallel process based on the South African experience of HIS development using the DHIS software (Braa & Hedberg, 2002). Three aspects of the HIS development are highlighted. First, 8 of the 27 LGA's were identified to serve as pilots - allowing the implementation team to gain experience and learn lessons in the initial implementation. Secondly, an EDS was developed for use across the PATHS states. The process of developing and gaining acceptance of the EDS did not occur without controversy. Major opposition to the EDS was received from senior Federal Ministry of Health (FMoH) officials who were advocating use of over 1000 data elements and a software product that provide little benefit to its users. Eventually, through high level negotiations, an agreement was reached that an EDS of 127 data elements, which could provide data on 74 indicators, would be used as a pilot in the PATHS states only. Subsequently (in 2005) a slightly modified version has been used as the standard across the country. Thirdly, the DHISv1.3 software was adapted to the Nigerian context, and used at the state level for data capture and analysis of monthly facility reports.

¹² Obtained from various sources, including data used in the DHIS for population data



In the absence of technology, reliance is made on paper based IS for data collection and onward transmission, from facility, through local government authority level, and up to state level (Figure 2). Data capture occurs at state level. Gateways are used at two levels. A paper-paper gateway transfers data from patient registers to monthly reports (facility level), and a paper-computer gateway is used at the point of data capture (state level). Data is captured by two staff in the HMIS unit. The achievement of a 68% data coverage for the last 12 months (as at August 2006) is significant given the constraints (unreliable access to electricity, lack of funds for generator fuel and pressure on data capturers to perform other tasks), and only the PATHS states can claim similar data coverage rates.



A strength in Jigawa is that staff exist at each level, and have received training related to the HIS (Figure 1 and Table 4). Through these processes the in-country teams have developed capacity to continue basic training on their own. International support is available to support the more sophisticated aspects of the software, and of HIS implementation. Institutionalization of training initiatives is to be strengthened through establishing links with a local university.

Hierarchical level	Numbers of staff	Staff involved in the HIS	Access to computers and electricity
Facilities	508	At least one person in each facility participated in training on use of information	Seldom have access to grid electricity. May have solar panels, which often are non-functional. Rely on paper based data collection, but paper itself is in short supply.
Local government	27	One PHC Coordinator (political level) and an Monitoring and Evaluation Officer ¹³	Grid electricity is unreliable. Almost no computers at this level.
State Ministry of Health	1	State HIS Officer, and 2 data entry clerks	Grid electricity is unreliable, and more often than not reliance is on a generator which usually only runs “when certain senior officials are in the office”. Three computers and one laptop

Table 4: Overview of access to staff and computers in the Jigawa Health System

4.2.1. Summary:

The phases in the HIS strengthening initiatives in Jigawa are presented in Table 5.

Phase	Time period	Activity	Comment
I	Sept 2003 - Jan 2005	Pilot in 8 LGA's	EDS defined, data flow improved, new process of data capture using DHIS1.3 at state level introduced, intense training provided
II	Jan 2005 - Jan 2006	Horizontal scaling across geographic areas (LGA's)	EDS held static and data capture maintained at state level, increase in volume of data (additional LGA's), intense training by local team (demonstrating some capacity been developed)
III	Jan 2006 - Aug 2006	Consolidation period	Efforts directed at improving adherence to data flow and improving data capture process Efforts to encourage use of information Advocacy meetings with senior managers
IV	Nov 2006	Conversion DHIS13 – DHIS14	All else held static – training to be provided on new version of DHIS
V	Jan 2007 onwards	Decentralizing data capture to gunduma	Still to take place, but has been discussed, and planned for about 18 months.

Table 5: Phases in HIS Strengthening Activities

Phases three through five require specific mention. Phase three is a consolidation period. A number of workshops have been convened where existing data (even if incomplete) is used as a means to encourage LGA's to ensure that at least 90% of their facilities report. Interestingly, the ability to present and analyze data has created huge interest amongst program managers at the State and Federal levels as, for the first time, comparative data has been presented across the five PATHS states. The upshot of this has been that HISP-Nigeria has now been asked to implement DHISv1.4 and provide training to all remaining states in Nigeria!

¹³ In reality, there are more people involved at this level, as many of the vertical programmes have their own “M+E officers” – reflecting the constant battle between integration and verticalization (fragmentation) of services, especially in an environment which has a large donor driven component

Phase four involves the conversion from DHISv1.3 to DHISv1.4, and is currently underway. During 2003/04 a new improved version of the DHIS software, called DHISv1.4, was being tested in South Africa, Botswana and Zanzibar. In Nigeria though, the introduction of this more powerful and efficient version was delayed till late 2006, because at the time the team had limited capacity to absorb new initiatives. In August, Kano state began to use the DHISv1.4, and as implementation proceeded smoothly, training is currently being done in Jigawa (and offered to other states to attend as well). The process of transition to DHISv1.4 reflects the cultivation processes used so successfully – not only in that piloting in one region is initiated before larger scale implementation, but the translation to a newer version of the same software is also a cultivation process.

Phase five is still to be enacted, namely the decentralization of data capture to gunduma level. Ideally data capture should occur at the LGA level. But, in this case 27 computers accompanied by generators, UPS systems, and secure and dust free abodes need to be provided, as well as training and support to the 27 HIS Officers. This is not achievable given the current access to resources. Rather, the plan is to scale to gunduma's, and to provide an additional 6 computers, and generators, and to locate these at hospitals (where power supply would be more regular and a secure and dust free environment is more likely to be found). Each would capture data from about 85 facilities. Training on the use of the DHIS software will draw on those LGA HIS officers who are dedicated and reliable. New HIS officers from facility staff will be identified to support the LGA level. Scaling in this way potentially trebles the pool of data capturers, and also shifts the responsibility one step down the hierarchy in a manner consistent with resource availability.

4.3. Information systems development in Amhara Region State - increasing the data volume

The flow of information is similar to that in Nigeria (Figure 2). However, prior to the project initiation, the Woreda Health Offices compiled summary reports (using the health facility reports), and the aggregated report was submitted to the zonal office, which sent it to the ARHB (Amhara Regional state Health Bureau) and then to the FMoH. During the aggregation process, the identity and details of the original facility data was lost, making it impossible to trace data back to a single facility. Data capture occurred at the Regional level. Prior to the initiation of the HISP project, the existing HIS has been a one way reporting system designed to report data to higher levels and vertical programs without any feedback to the lower levels. An EDS was developed over an 18 month period (up to December 2005) using a participatory approach and with support of the RHB. Standardized reporting formats were developed, and the DHISv1.4 was customized for implementation at regional and zonal levels. The new reporting system brought about changes to the flow of information – facility reports would be captured instead of aggregated data. This created a tenfold increase in the volume of data, as instead of monthly reports from 119 woreda's, 1047 monthly facility reports were to be captured. As a result, there was a need to decentralize data capture to zonal, and possibly woreda level.

A survey of access to staff, computers, and internet was conducted (Table 6). This shows how access to computers, telephone and electricity both at zonal and district levels has improved remarkably in the last few months, although surprisingly the level of internet connectivity both at zonal and district level remains low (but is likely to be addressed through a large World Bank and International Monetary Fund (IMF) funded project - WoredaNet). A critical problem though is the lack of assigned HMIS staff to specifically do HMIS related activities, and they do not have the skills and training with regard to modern information and communication technologies.

Zone	Districts (Woredas)	Districts with access to telephone & electricity	Districts with computers	Districts with internet (Dial-up) access	Districts with assigned personnel for HMIS
North Gondar	18	16	10	2	None (not even at Zonal level)
South Gondar	10	9	8	1	2
Wag Hemra	4	3	3	None (not even at zonal level)	0
North Wello	9	9	7	1	2
South Wello	18	14	11	1	None (not even at Zonal level)
Oromiya special zone	5	3	2	None (Not even at zonal level)	0
North Shoa	20	18	18	None	None (not even at Zonal level)
East Gojam	15	11	7	1	None (not even at Zonal level)
Awi zone	6	4	4	None (not even at zonal level)	0
West Gojam	13	12	9	None (Not even at zonal level)	None (not even at zonal level)
Bahir Dar Special zone	1	1	1	None (not even at zonal level)	0
Totals	119	100	80	6	4

Table 6: Analysis of access to computers, internet and staff in Amhara Regional State

To address the skills gap, a two week training course for staff from the 11 zones was conducted in May 2006 by the HISP-Ethiopia team. As many trainees had very limited computer literacy skills, the first three days were devoted to increasing their familiarity with MS Office applications, (specifically MS Excel and MS Access since they are linked to the DHISv1.4 for report generation and data analysis). The remainder of the training focused on the principles of data capture in DHISv1.4. At the end of the training, trainees were provided with installation CD's, and were instructed in the installation procedure for the software. However, shortly thereafter the HISP team started to receive phone calls from zonal health departments requesting support on the installation process. In July 2006, when a team of three HISP members (including one of the authors) conducted follow-up on-site training in the zones, they found that none of the trainees had managed to successfully install the software in their computers. This was due to the low computer literacy of the trained staff who had difficulty grasping the installation procedure. As the HIS focal person in one of the zones indicated:

“...the training given for us in May 2006 in Baher Dar was good, but for most of us with less background and knowledge even on basic computer applications, the complex instructions and dialogue boxes popping up during installation of DHIS software makes it very difficult for me to successfully install and use the system.”

We see in this example, how, the balance between the human resources (numbers, and skills levels) and the technology needs to be managed, otherwise the technology will not be used to its full potential. An alternative option that is now under consideration, instead of trying to achieve homogenous scaling to all levels at the same time, would be to scale to those woreda's that have the capacity to absorb the

training and which have the technology available. We thus allow uneven development to occur, but through a cultivation strategy.

4.3.1. Summary:

In Amhara Region then, we can discern three phases to the HMIS strengthening activities (Table 7).

Phase	Time period	Activity	Comment
I	June 2004 - Dec 2005	Period of consultation and buy in	EDS defined, data flow changed with huge increase in data volume
II	Jan 2006 - current	Vertical scaling of data capture to zones	Training and support for data capturers
III	Oct 2006 – Jul 2007	Vertical scaling of data capture to selected districts	Training and support for data capturers

Table 7: Summary of HIS Implementation in Amhara Regional State

5. DISCUSSION:

We see in these examples, an interesting interplay between what we have termed the three spheres of the IS, the data sphere, the technology sphere, and the human resource sphere. These are presented in a model (Figure 3). The three spheres are interlinked with one another in complex ways, and understanding and being sensitive to the complexities of these inter-linkages is important in “innovating mindfully” with technology. The oval shapes represent an assessment of the capacity of each state in relation to the three spheres. Jigawa and Amhara Region differ in their human resource capacity and access to technology and this has had implications on the volume of data that they can effectively manage, and the process for strengthening the HIS.

In Nigeria, centralized data capture was initiated because of the absence of ICT infrastructure in the periphery, and despite the presence of sufficient staff there. However, data capture of 508 facility reports in a central office is not an easy task. It was kept manageable by limiting the EDS to a small number of data elements. Decentralization (scaling along the vertical axis) is proceeding “cautiously” as ICT infrastructure improves. In Amhara, the process was driven by the need for disaggregated data (increased depth of penetration of the hierarchy) resulting in an explosion in the volume of data. Given the relatively good access to ICT, decentralized data capture was possible, despite the limited availability of staff. However, the implementation plan had to be re-assessed because efforts at improving staff capacity were hindered by their limited ability to absorb the training. As HIS implementation proceeds, so the capacity in each of the spheres changes (skills improve, access to technology improves, and data volume may increase), and a never-ending spiral results as the balance is maintained. As the process spirals the HIS is scaled.

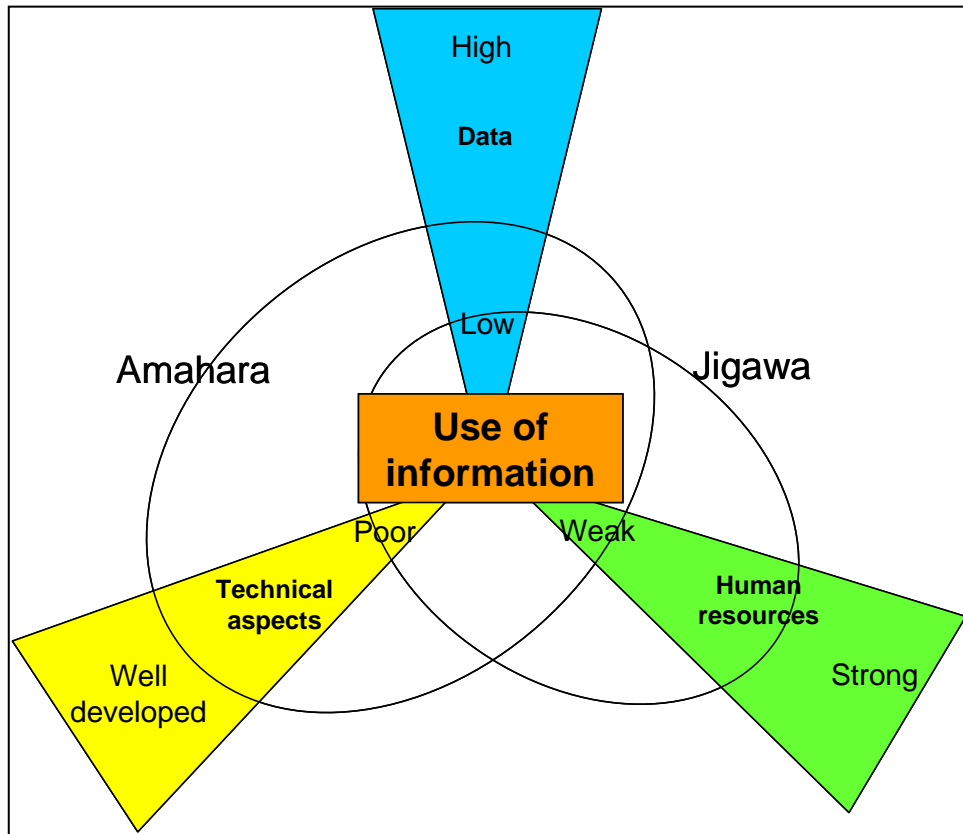


Figure 3: The influence of resource availability on HIS development

Based on an iterative process of analysis of the case material, the factors that affect each sphere are presented in Table 8. Given the importance of balance between the three spheres, this analysis is a useful checklist which can be used (in support of “a sensitivity to operations”) to assess the strengths and weaknesses in an organization where scaling is planned. For instance in the Amhara example, the decision to capture facility data (meaning the depth of penetration of the health system by the HIS–Table 1) increased the volume of data to be captured, resulting in a need for increased data capturing capacity. How could this be achieved within resource constraints? Lead districts can be identified by assessing which best fit the criteria listed in the table. In this way, uneven development can be used to spearhead scaling of HIS. The analysis thus helps identify which areas can be successfully scaled ahead of others.

SPHERE	CONTRIBUTING FACTORS
Data components	Volume of data, affected by: Extent of integration from vertical programs (Jigawa) Geographic scope (e.g. In Jigawa, 8 of 27 LGA's piloted) Granularity of data (penetration of hierarchy from national to community and individual levels – the Amhara example)
Human resources aspects	Numbers of staff (Jigawa and Amhara) Skills level of staff (Amhara) Ability to provide support (Jigawa and Amhara) Ability to train and build capacity (Jigawa)
Technical aspects	Scalable processes integrated in the information system (Jigawa and Amhara) Software appropriate and scalable (Jigawa and Amhara) Access to computers (Jigawa and Amhara) Access to internet (Amhara)
Table 8: The Factors Contributing to Each Sphere	

The concept of utilizing lead districts to spearhead scaling and HIS development warrants further exploration. Development of the HIS and local commitment, the level of its use and quality of data, will typically proceed at an uneven pace between districts. Local champions and otherwise favorable conditions in individual districts may typically lead to “best practice” districts. An effective scaling strategy needs to support these lead districts and actively use these best practices in the horizontal scaling of the HIS to other districts. More concretely we have seen how best practices have turned into “attractors for change” (Eoyang, 1996) by creating support and interests and thereby sufficient momentum and “critical mass” to bring about changes also in other districts.

A cultivation approach, characterized by mindful innovation is required to maintain the spiral as HIS are scaled. In order to minimize the risk of failure then, careful attention to the context is required, and in particular to the ability to accommodate and absorb change (a sensitivity to operations). Inefficiencies may need to be accepted because of imbalances between the three spheres (in the case of Jigawa the inefficiency of centralized data capture, in Amhara the need for a reconsideration of the decentralization strategy). Further examples are summarized in Table 9.

Characteristic	Examples from case material
Preoccupation with the possibility of failure	Nigeria: Careful planning prior to implementation at Gunduma. Constant consideration of how sustainable IS are developed Ethiopia: Conducting survey to assess capacity prior to implementation.
Commitment to resilience	Nigeria: Delaying introduction of DHIS14 till conditions were favourable. Ethiopia: Follow-up training support provided when trainees did not understand instructions sufficiently
Sensitivity to operations	Nigeria: Decision to first decentralise to Gunduma before going to LGA level. Holding other changes back when introducing DHIS14 Ethiopia: Allowing uneven development to occur
Table 9: Brief description of some characteristics of mindful innovation	

In reality, as HIS are scaled, and experience is gained, the relative balance between the three spheres is likely to change. The position of the Amhara spiral in Figure 3 reflects the average situation across the state, but in fact it could be composed of 11 very different zonal spirals, or 119 woreda spirals, each depicting differences in access to resources. As changes are brought about, whether by a need for increased data volume, or as additional staff are brought on board, or as access to technology improves, the balance needs to be reestablished. The challenge in scaling is to keep the balance between the three spheres. This can be achieved through a process of improvisation, using the available resources optimally, and innovatively. Plans and implementation processes need to be constantly assessed and adapted. In our cases, mindful innovation has entailed the synergetic interaction between the three spheres, but has also been influenced by the use of information. This is the third dimension depicted in Table 1, and is required for vertical and horizontal scaling. Improved quality of data and information, such as reports that address managers' (and other users, as in the Nigeria case) needs, are both caused by and causing improved human resources, which again lead to an improved system including the technical aspects. While the users are learning how the system can serve their needs and thereby sparking gradually more advanced requests, those involved in the systems development are learning how to meet these requests. Through this iterative process, the software and overall system are being gradually improved. As ownership and perceived usefulness increase, vertical and horizontal processes will need to be replicated at each level (e.g. district, state/region, national) of the health system as scaling occurs. IS development occurred through small changes and problems are overcome through adjustments of the "ideal" plan to one which is dictated by practicalities (the factors that affect the spheres).

This brings us to our research question, namely are there aspects of an IS which can be scaled unproblematically?

6. CONCLUDING REMARKS:

Considering the factors depicted in Table 8, we cannot say with absolute certainty that there was any single factor that was able to be scaled "unproblematically" – the nature of the local context, and the access to resources, required specific adaptations to be made for each of the factors. But, drawing on the case descriptions, and similar accounts in the literature (Braa et al., Forthcoming; Braa et al., 2004; Rolland & Monteiro, 2002), it is clear that certain strategies are central to successful scaling. The first is the concept of the EDS (and which will not be further elaborated here). The second is in the

technical sphere, and is depicted in Figure 2 - a scalable process of information collection and collation consisting of gateways between paper based systems and hardware and software which can be interfaced with one another at various levels of the hierarchy as access to technology changes, and which can accommodate heterogeneous (uneven) development across geographic areas. The third represents the cultivation process – or the spiral itself – which includes improvisations and a variety of ways to develop, facilitate and motivate increased information use, local champions, commitment and ownership. We have seen that the development of lead districts, good examples and attractors for change are crucial elements in the cultivation and scaling strategy. These three strategies have been identified as “flexible standards” (Braa et al., Forthcoming), and as can be seen in Table 1, they support the scaling process (and the changes that accompany scaling) across geographic scope and depth of penetration of the hierarchy of the health system. We would thus conclude that “flexible standards” are strategies that can be scaled on a global level, but that for the successful scaling of HIS, it has to be accompanied by a local cultivation process that balances the spheres of volume of data, access to technology, and human capacity.

7. ACKNOWLEDGEMENTS:

We wish to pay tribute to all our counterparts working in the remote regions of Jigawa and Amhara, and those in the administrative offices at the district, or regional levels who have supported our efforts at improving the IS.

8. REFERENCES:

- Aanestad, M. (2002). *Cultivating Networks: Implementing surgical telemedicine*. University of Oslo, Oslo, Norway.
- Begun, J. W., Zimmerman, B., & Dooley, K. (2003). Health Care Organizations as Complex Adaptive Systems. In S. M. Mick & M. Wyttenbach (Eds.), *Advances in Health Care Organisation Theory* (pp. 253-288). San Francisco: Jossey-Bass.
- Bergqvist, J., Dahlberg, P., & Ljungberg, F. (2002) Scalability through Cultivation - designing IT support for co-ordination work. Retrieved 13 November, 2006, from <http://citeseer.ist.psu.edu/cache/papers/cs/23947/http:zSzzSzwww.dahlberg.sezSzpubzSzmast er.pdf/scalability-through-cultivation-designing.pdf>
- Braa, J., Hanseth, O., Heywood, A., Mohammed, W., & Shaw, V. (Forthcoming). Developing Health Information Systems in Developing Countries - the flexible standards strategy. *MIS Quarterly*.
- Braa, J., & Hedberg, C. (2002). The Struggle for District Based Health Information Systems in South Africa. *The Information Society*, 18, 113-127.
- Braa, J., Monteiro, E., & Sahay, S. (2004). Networks of Action: Sustainable Health Information Systems Across Developing Countries. *MIS Quarterly*, 28(3), 337-362.
- Eoyang, G. "Complex? Yes! Adaptive? Well, maybe..." *Interactions* (3:1), 1996, pp. 31-37.
- Hanseth, O. (2002). From systems and tools to networks and infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology implications. Retrieved 2 September, 2005, from http://heim.ifi.uio.no/~oleha/Publications/ib_ISR_3rd_resubm2.html
- Jacucci, E., Shaw, V., & Braa, J. (Forthcoming). Standardization of Health Information Systems in South Africa: The Challenge of Local Sustainability. *Information Technology for Development*, ().
- Kano State Economic Planning Committee. (2004). Kano State Economic Empowerment and Development Strategy (K-SEEDS).
- Ministry of Health (MOH) [Ethiopia]. 2005. *The Health Sector Strategic Plan (HSDP III)*. Addis Ababa, Ethiopia: Ministry of Health.
- Mitcham, C. (1994). *Thinking through Technology. The Path between Engineering and Philosophy*. The University of Chicago Press, Chicago. 397 pages.

- Monteiro, E. (1998). Scaling Information Infrastructure: The Case of the Next-Generation IP in the Internet. *The Information Society*, 14(3), 229-245.
- Monteiro, E. (2000). Monsters - From systems to actor-networks. In K. Braa, C. Sorenson & B. Dahlbom (Eds.), *Planet Internet*. Lund, Sweden: Studentlitteratur.
- Rolland, K., & Monteiro, E. (2002). Balancing the Local and the Global in Infrastructural Information System. *The Information Society*, 18, 87-100.
- Sahay, S., & Walsham, G. (2005, 26-28 May 2005). *Scaling of Health Information Systems in India: Challenges and Approaches*. Paper presented at the International Federation for Information Processing Working Group 9.4 Conference, Abuja, Nigeria.
- Shaw, V. (2005). Health information system reform in South Africa: developing an essential data set. *Bulletin of the World Health Organisation*, 2005(83), 632 - 639.
- Shiffman, J., Okonofua, F. E., & Ved, R. (2006). The State of Political Priority for Maternal Mortality REduction in Nigeria and India [Electronic Version]. Retrieved 14 November 2006 from <http://paa2006.princeton.edu/download.aspx?submissionId=60071>.
- Swanson, E. B., & Ramiller, N. C. (2004). *Innovating mindfully with technology*. *MIS Quarterly*, 28(4), 553-583.
- Walsham, G. (1993). *Interpreting Information Systems in Organizations*. Chichester, England: John Wiley and Sons.
- Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (1999). Organizing for High Reliability: Processes of Collective Mindfulness. *Research in Organizational Behavior*, 21, 81-123

APPNDIX III

Kimaro, H. C.; Mengiste, Shegaw. A. and Aanestad, M. (2007). Redesigning Health information Systems in Developing Countries: The need for Local Flexibility and Distributed Control. *Journal of Public Administration and Development*, 28: 18-29.

REDESIGNING HEALTH INFORMATION SYSTEMS IN DEVELOPING COUNTRIES: THE NEED FOR LOCAL FLEXIBILITY AND DISTRIBUTED CONTROL

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SUMMARY

Despite widespread aims to strengthen the Health Information System (HIS) as a tool for decentralised health care, there is a strong tendency in most developing countries that the HIS continues to reflect the central level's needs and requirements. The traditional design approach with little or no end user involvement results in a centralised HIS with an extensive, somewhat inappropriate, but also inflexible set of standards. Consequently, the HIS is not very useful for the wished-for decentralisation of health services, and there is an urgent need to redesign the existing HIS in order to make it locally relevant and appropriately decentralised. Based on a comparative case analysis of the HIS in Tanzania and Ethiopia, we offer practical recommendations on the way to achieve this redesign. A central design goal should be to achieve a balance between centralised control and local autonomy. Some degree of control over a decentralised HIS, including budgets and the use of resources, should be delegated to the district administration. In order to achieve the aim of a locally relevant, well-working HIS, it is necessary that appropriate authority, capacity and decentralised allocation of resources for HIS will be developed at the district and sub-district levels. Copyright © 2008 John Wiley & Sons, Ltd.

KEY WORDS — Health Information System; flexibility; distributed control; decentralisation; Tanzania; Ethiopia

INTRODUCTION

The World Health Organization (WHO) conference held in Alma Ata in 1978 declared the Primary Health Care (PHC) approach the most suitable way to organise health service delivery to respond to health problems of the majority of people living in rural communities (WHO, 1978). The idea behind the PHC is essentially to establish a decentralised health system with a focus on equity and accessibility of health care services delivered by the primary health facilities in the community in developing countries (Sandiford *et al.*, 1992; WHO, 1994).

Decentralisation of delivery of public services and decision-making is an aim of most donors and national governments (Galvin and Habib, 2003). Decentralisation implies transfer of decision-making, planning, budgeting, management and resource allocation of PHC services from the national to the district and sub-district levels (Litvack *et al.*, 1998; Wunsch, 2001). The goals of decentralisation are to enable timely decision-making and allocation of resources and increased community participation to contribute to a more effective and equitable provisioning of health services (Görge *et al.*, 2004). In the context of developing countries such as Ethiopia and Tanzania, the goals of decentralised health care services are however not easily achieved. One reason is the lack of appropriate financial, technical and managerial capacity, as a result of insufficient implementation of decentralisation reforms. Issues of training and financial capability have for a long time been identified as challenges (Adamolekun, 1991). The fundamental ideas behind decentralisation may be appreciated only to a limited degree, since the dominant view to which most public officials have been exposed during training is likely to

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advocate the hierarchical principle as the most appropriate model for social organisation (Olowu, 1989). Sometimes key changes in legislation are not done, leaving local governments unable to discharge their responsibilities (Wunsch, 2001). Other challenges that have been identified are the lack of appropriate intergovernmental mechanisms, as well as models for how to create local bodies that do not exploit their powers (Olowu, 2003). As with any other reorganisation or reform, it 'is in the "nuts and bolt" of the change [that] many obstacles are found' (Wunsch, 2001; 277). In this article, we address one of these concrete tools for actual work, the Health Information Systems (HISs), which are often ineffective (Mwangu, 2003).

This article attempts to address the challenges of HIS, which we argue play a crucial role for supporting decentralised health delivery systems. The responsibility of the decentralised local authorities is to administer health services by developing relevant health plans and local interventions using available resources. For this task, an effective HIS with updated information on disease burden and the performance of health services is crucial (World Health Report, 2004; WHO, 2004). An effective HIS may also help making the local health problems more visible which can provide the basis for greater advocacy and raise political will to attract more focused resources to the local level (Mosse and Sahay, 2003). Beyond the local context, the HIS should also contribute to the information needs of the higher levels in the health administration. Relevant and accurate information is needed for the formulation of effective national policies to ensure equitable distribution and accessibility of health services.

The recognition that effective HIS is essential for effective functioning of the PHC system is indicated in various national health policy documents, strategies of donor agencies (WHO, 2004) and research studies (Braa and Blobel, 2003; Braa *et al.*, 2004). However, in reality the existing HIS in developing countries is usually not well-working, leading to inefficient management and improvement of health services and hindering the health care services reform through decentralisation. Consequently, the current HIS is not very useful for the wished-for decentralisation or establishment of the PHC.

In this article, we draw on the empirical material from Tanzania and Ethiopia, two countries with different administrative structures when it comes to decentralisation of the health care sector. We have conducted an empirical study to determine (1) how the actual degree of political and administrative decentralisation allows or restricts the workings of the HIS, and (2) how the existing HIS contributes to or restricts the wished-for decentralisation. Our aim with the article is to emphasise the needs of the local level, which we believe is overlooked, but crucial to address if the visions behind the PHC approach shall be reached.

In the next section, we introduce HIS in more detail, and focus on problems commonly found in developing countries as well as the role of HIS in facilitating and sustaining the decentralisation of health care. We then give methodological details of our study, present an overview over the health care system in the two countries before we report our findings on HIS. Based on this study, we give practical advice on how the balance between centralised control and local autonomy could be struck.

HEALTH INFORMATION SYSTEMS

A HIS is a combination of people, tools (e.g. ICTs, paper form and reports), and routine procedures (for data compilation, processing, reporting and use) organised to provide and use routine health information (Boerma, 1991). The data that are reported in the HIS are collected by individual health workers in various health facilities, using register books and tally sheets provided by the health authorities. The data gathered are both statistics on patients attending various health services (e.g. number and diagnoses for outpatient attendances, number of children immunised, number of deliveries etc.) and information on use of resources (e.g. drugs) and availability of equipment. At regular intervals, for example, monthly or quarterly, the person responsible for information handling at the facility aggregates these data (which is usually done manually), enters them into standardised reporting forms and transmit these forms to the health service management at higher levels. In the countryside the means of transport is usually bike, animal (horse or mule), public transport or occasionally car. At the health facilities there are usually no computers available, while some of the district level offices will have a computer both in Tanzania and Ethiopia. If a computer is available, the data from the underlying health facilities are manually entered into the computer, aggregated by the software and the required reports are generated and transmitted to higher levels, on

diskettes or flash disks. Whether the data aggregation and reporting is done on article or is computerised, the degree of local analysis and data usage is very low. The reporting is mainly understood as fulfilling a duty imposed by the higher levels.

An effective HIS highly depends on the availability of local capability of the people involved to understand and manage the HIS and to make sense of the information generated and to bring effectiveness and efficiency in the delivery of health services. Despite widespread aims to strengthen the HIS as a tool for decentralised health care, there is a strong tendency in many countries that the HIS reflects the central level's needs, capability and requirements (Opit, 1987; Piotti *et al.*, 2006), since there has usually not been any participation from end users at the local level in the design process. Neither have there been appropriate strategies to improve capability of the local end users through regular training (Kimaro, 2006). This design approach often results in a centralised HIS with an extensive, somewhat inappropriate but also inflexible set of standards for health data, data collection tools and software (Lippeveld *et al.*, 2000; Chilundo and Aanestad, 2004; Kimaro and Nhampossa, 2005). Partly as a consequence of this, the HIS is perceived as existing for upwards reporting of information, taking a secondary role to the health care work itself. This is far from the intentions of encouraging local use of information (Sandiford *et al.*, 1992). The consequences are low data quality and irregular reporting (Mwangu, 2003). This again leads to the establishment of multiple specialised HIS that is linked to specific vertical health programmes, such as, for example, tuberculosis, HIV/AIDS, malaria etc. The vertical programme-specific HIS is even more rigidly standardised with respect to data sets and reporting formats, and do not allow any change or modification to be undertaken at lower levels. Usually these vertical programmes operate with permission from the national Ministry of Health (MoH) and are not necessarily subjected to the local health authorities. These multiple information systems are not coordinated at lower levels leading to redundancy in the data collected and a high workload on the personnel (WHO, 1994; Braa and Blobel, 2003; Chilundo and Aanestad, 2004), which further weaken the performance of the national HIS. These problems are widely acknowledged, and large-scale coordinated initiatives such as the Health Metrics Network (HMN)¹ have been launched. The HMN calls for coordination and alignment of all involved parties in order to harmonise countries information systems, and intends that by 2011 the 'Framework and Standards for Country Health Information Systems' (HMN, 2007) is universally accepted as the standard for HIS. The linkage between flexible HIS and decentralised health care management is a theme also in this framework, but unfortunately it is not much emphasised in the recommendations.

We want to focus on exactly this theme. Currently the HIS do not sufficiently support management and operation of decentralised health care services. By the health workers they are regarded as imposed and ineffectively designed systems. However, as our argument goes, the current status of decentralisation is also hindering the local usage of information and improvements of the HIS. A successful and sustainable approach must recognise this inter-linkage and address all aspects that contribute to this deadlock situation.

RESEARCH SETTING AND APPROACH

The research was conducted in Ethiopia and Tanzania, both of which face serious constraints related to poor physical and communication infrastructures while depending significantly on donor agencies for the provision of funds. Ethiopia is located in the North eastern part of Africa with a total area of around 1.1 million km² and a total population of 71 million. Tanzania is located in Eastern Africa with a total area of about 945,087 km² and a population of about 34.4 million. The Ministries of Health in Ethiopia and Tanzania have for over a decade attempted to implement reforms of their HIS with limited results.

The two case studies presented in this article draw upon material collected across different levels of the public health care administration. Both case studies were part of an action research initiative within the Health Information Systems Program (HISP) (for details see Braa *et al.*, 2004, or www.hisp.info) with the aim to strengthen processes of design of effective HIS in developing countries with a focus on building the local capacity to use information for

¹<http://www.who.int/healthmetrics/en/>

local action. The two case studies are based on the first two authors' individual experiences as researchers since 2003 in their respective countries, Tanzania and Ethiopia. Data have been collected through semi-structured interviews, document analysis, observation and discussions during workshops and training seminars. Interviews were conducted with health workers at all levels of the health care system, namely health service providers at the health facilities, in-charge of health facilities, health programme/information coordinators (experts and team leaders) at both the district, regional and national levels. A total number of 45 interviews were conducted in Ethiopia and 56 in Tanzania, focusing on issues around HIS-related procedures, experiences and problems. Analysis of documents such as reporting forms, graphs, tally sheets, copies of monthly reports and registers was also conducted, together with observation of health workers while they perform data collation and analysis tasks. Comments and feedback of participants of workshops conducted was also used as a data source for this study.

HEALTH INFORMATION SYSTEMS AND DECENTRALISATION

In the following sub-sections, we will give a brief overview over the administrative structures of the Tanzanian and Ethiopian health care systems, before discussing decentralisation of health services and the HIS.

The health care system in Tanzania

The Tanzanian health system was derived from a colonial, urban, curative-based health system that placed little emphasis on equity and accessibility of health services for all. The health service delivery was disorganised and constrained by an extreme shortage of manpower and financial resources. Since Tanzania's independence in 1961, the government has taken deliberate efforts to alleviate some of these historically inherited inequities through expanding the health services to the rural areas and training of paramedical staff. The Tanzanian MoH started new attempts in 1994 to decentralise the health services through the devolution of administrative power to local government authorities. The district government was given responsibility of administering PHC health facilities (i.e. village health post, community dispensaries and health centres), so as to increase efficiency and accountability.

Tanzania has achieved major progress with regards to the distribution of health facilities with more than 72% of the rural population living within 5 km of a health care facility and 93% within 10 km (UNICEF, 1990). However, disparities still exist in the distribution of the facilities with some areas having more health facilities than others. Also PHC sector typically still face a shortage of trained manpower and inadequate resources. The health budget remained inadequate, centrally controlled and donor dependent (Kopoka, 2000). These inadequacies contribute to poor health services and drug shortages. While malaria remains one of the nation's biggest killers, HIV/AIDS and tuberculosis are on the increase.

PHC administration and management

At the district level, management and administration of health services is vested to district councils with technical guidance of the Council Health Management Teams (CHMT; a team of health staff headed by district medical officer). At the regional level, provision of health services is vested to the regional administration with technical guidance of the Regional Health Management Team (RHMT). The RHMT is also responsible for supervising the region's health districts. The national MoH is responsible for making and monitoring national health policies, standards, reforms, as well as training of key cadres and provision of national tertiary level referral services.

The district council is responsible for administration of the PHC facilities. The CHMT is accountable to the district councils, and it is responsible for the supervising and monitoring of PHC services in the health facilities. In practice, the CHMT require routine health information from the HIS in order to work effectively. For instance, the CHMT is supposed to react on the performance indicators based on set targets and use the HIS information compiled for preparing a district health plan. This plan is prepared every quarter as a basis for requests for funds from the district council, the central level or relevant donor agencies. The district health plan is based on identified priorities of diseases burden and district needs, and is designed to meet the set objectives and targets on health of the population. The CHMT also prepares routine reports on diseases and activities for submission to the RHMT which in turn compiles the reports for reporting to the MoH.

Decentralisation in practice

Although the responsibility for PHC services is decentralised, district local government still depends on the higher levels for resources and guidance. For example, the disbursement of funds based on the submitted health plan is often not timely. Also, once the money is allocated based on the approved health plan, the districts cannot change its use without higher-level approval; otherwise, it is regarded as violation of financial regulations. The planned activities of CHMT are also sometimes subject to interference by higher-level officials and donors. For example, the district-level officials may be asked to participate in centrally driven projects or attend frequent requests for ad hoc reports (besides the routine reporting). The consequence of this is that they often do not get time to conduct timely and effective supervision of the health services (Hutchinson, 2002). One of the district HIS coordinators said:

'The health managers and CHMT have so many responsibilities which some of them are acutely needed by higher authorities. They sometimes go to the seminars and workshops. So the time of scheduled supervision and time of verifying data is missing. Also delay of funds from higher level contributes to delay in performing supervision'.

Generally few trained cadres (rural medical assistants) existed in rural health facilities for diagnosing and treating patients as well as for performing data collection and information handling (Bijlmakers *et al.*, 2004). However, despite severe shortage of health staff in the health facilities, the district councils had no flexibility to employ new staff without higher-level approval even if they had the necessary resources. Also, district health managers complain about the insufficient and untimely disbursement of funds to the districts from central government makes motivating health staff difficult, delay the procurement of resources, and affects the conduct of monthly supervision of health services. In addition to the lack of timely and adequate resources, CHMT members lack sufficient capability to take greater responsibility for health services management including of curative services (Harpham and Few, 2002) and the HIS.

The health information system at district and facility level

In 1989, the MoH started the process of developing a comprehensive paper based Health Management Information System (HMIS) followed by its implementation and computerisation in 1993 (HERA, 2000; Rubona, 2001; Mwangu, 2003). The main goal of these efforts was to improve the performance of health services through providing stronger information support and to integrate all vertical programmes (MoH, 1993). The HMIS design followed the existing administrative structure of four levels: health facility, district, regional, and the national.

Despite the aim that the HMIS would be developed primarily for strengthening the local levels, its actual design process did not include the end users (Mwangu, 2003), including district-level officials, despite the district level being (in theory) the focal point for data aggregation and information flows. The inefficiencies of the HMIS necessarily have forced the managers of the vertical health programmes to develop their own systems overburdening an already busy health staff. Presently there are numerous vertical programmes, each with their own information coordinators, material supplies (e.g. drugs), support equipment (e.g. cars), data collection mechanisms as well as specific data analysis tools (such as forms and registers, software and hardware).

The responsibility for handling information at the facility, district or regional level is usually not seen as very attractive. It comes in addition to the ordinary work duties of health care provision, but without the benefits (financial and otherwise) that the so-called vertical programmes can offer. The person is given the tasks of handling district health information without any extra training. A Regional Health Secretary stated that:

'Usually someone who is able to do extra job and can spend more working hours without complaints is selected as district HMIS coordinator/focal person'.

In theory, health facilities are to be supervised by the CHMT on monthly basis, which is intended to give an opportunity for data validation, training and feedback. In practice, CHMT delegates everything about data to the district HMIS coordinators. One of the HMIS district coordinators expressed that it was 'hard for one person to visit several health facilities per day while collecting and validating the reports'. Thus, in practice, validation of data at

the facility was generally not done. Health workers at health facilities only received reports sent being returned back for corrections such as missing data.

In addition there was considerable fragmentation, as every health services section and vertical programmes collected, processed and utilised its own data. A District Nursing Officer said,

'When HMIS started it was one comprehensive system and there was no much burden. But as time went on several systems emerged some requiring detailed data for every month, for example, EPI. Others are malaria (for pregnant mothers), HIV/AIDS (for home visits). All these require separate reporting adding burdens to the health workers who have lots of other tasks to do. It is important to have one system instead of having huge bundles of papers to fill in, some with loose papers which make it even difficult to handle. When health staff makes mistake they often clam that they are tired; today someone comes asking information for IDWE, another one comes asking for EPI, etc. A health worker sometimes is confused and don't know even where shel/he have kept the data! As a result you find most of data is cooked data'.

Moreover, sometimes the tools for data collection (e.g. tally sheets and register books) are not distributed to the health facilities on time from the MoH due to logistic problems and untimely production. Most of the health facilities visited during this study were either using the previous year's register books or using their locally created forms, trying to make them look like the register book they usually use. Also as one of the district health secretaries pointed that, 'most of the time health staff was busy with providing regular curative health services placing less attention to the data registration and compilation'. These problems resulted to data inconsistencies, delay in collection, compiling and reporting of data.

Consequently, data were collected just for the sake of the system and were seen as fulfilling an obligation of reporting to the higher levels. There was a general assumption that data are only needed at the MoH which controls the HMIS since the MoH has adequate skills, resources and control over HMIS (Mwangu, 2003). As a result, at the lower levels there was a limited evidence of the use of data (Mliga, 2003). Thus, despite the original intention of the HMIS to support decentralisation and facilitate local ownership and use of data (Rubona, 2001), these visions have not been realised in practice. We conclude with Mwangu (2003) that the Tanzanian HMIS is yet another impediment to improve efficiency and management of PHC services.

The health care system in Ethiopia

In Ethiopia, it was after the fall of the military regime in 1991 that the new government took initiatives to improve efficiency in resource allocation, and to improve accountability of the government and the public social services, including health delivery, to the population. The new Ethiopian constitution, introduced in 1994 created a Federal government structure composed of nine ethnically based regional states and two city administrations. The constitution grants the regional states the status of a nation and they were given rights of self-determination up to secession.

The public health care system in Ethiopia comprised the Federal MoH, regional health bureaus (RHBs), zonal health departments and district health offices (DHOs), with their respective health facilities—central referral (specialised) hospitals at the federal level, hospitals at regional, zonal and district levels and health centres, health stations and health posts at the district level. Due to the Government's commitment to further decentralise the decision-making power, districts are currently the basic units of planning and health management (HSDP-III, 2005).

The health care system in Ethiopia is largely underdeveloped and under-resourced and as a result can provide the basic services to only about 64% of the population (HSDP-III, 2005). A large number of the rural population has no access to basic health care services mainly caused by the inherited centralised health system (HSDP-III, 2005). In recent years, various steps have been taken to decentralise the health care system. With the devolution of power and resources to regional governments, public service delivery has to a large extent fallen under the jurisdiction of the regions and districts. The recent health policy put more emphasis on improving access to basic PHC services

through a decentralised state system of governance to fulfil the needs of the less privileged rural population that constitutes about 85% of the total population (HSDP-III, 2005).

PHC administration and management

The decision-making processes in the development and implementation of the health system are shared between the Federal Ministry of Health (FMoH), the RHB, zonal health desks (ZHDs) and the DHOs. As a result of recent policy measures taken by the Government, most zones have been eliminated in favour of giving the districts more responsibility and accountability and ZHDs are mainly working as liaison offices to facilitate and coordinate health data reporting from all districts in the zone. The DHOs have been made to play the pivotal roles of managing and coordinating the operation of the PHC services at the district levels (HSDP-III, 2005). The RHBs are autonomous entities which get their budget from the regional government and are accountable to the respective regional administrative council.

Decentralisation in practice

The district-based administrative structure has reduced the level of bureaucracy by shifting the decision-making power down to district health officials. This has significantly reduced the interference and influence of officials from the RHBs on local action and decision-making. The districts get their budget directly from the regional administrative council. In order to get their budget, the DHO will prepare a plan and submit it to the district administrative council. The district council then summarises the plan and budget of all sectors and submits to the regional administrative council for approval. Once the budget is released from the regional government, it is administered by the district finance and economic development office by using a 'single pool system'. In this system the entire budget allocated to different public sector offices at district level (such as education, agriculture, health and capacity building) is administered by the district Finance Office and monitored by the District Administrative Council.

Although district public sector offices (such as health, education, agriculture) are formally given autonomy in using their budgets, this is in practice hampered by the accumulation of authority and control in the hands of the district council officials. Health managers at district levels complain on the lack of local flexibility in using their budget to recruit manpower, purchase medicine and supplies according to their plan and needs. The existing recruitment regulations involve lengthy procedures to be approved by the district administrative council and the regional civil service programme office. As the head of a DHO indicated, recruitment of one health worker would take up to 8 months on the average. This significantly contributes its share in the existing lack of skilled manpower in districts. As the head of DHO in one of the districts visited in Amhara region indicated:

'The existing financial system is affecting district health offices in using their budget freely. There is still some political influence from the district administration council on the autonomy of the district health managers using their budget. There are even incidents where the money allocated to PHC is transferred to some other sectors such as capacity building without the knowledge and consent of the district health officers'.

While district administrative councils are empowered, the power and autonomy of sectoral district offices (such as DHO) has been restricted.

The health information system at district and facility level

The existing HIS in Ethiopia is poorly organised and un-standardised. The devolution of power from the Federal MoH to RHB has contributed to the creation of multiple HIS across regions. For instance, 150 health information reporting formats were identified in one of the regional states (HSDP-III, 2005), and these do not conform to the reporting formats of other regions. In addition, disease-specific health programmes typically have separate sets of data collection instruments, data sets and indicators which are managed by each respective health programme. The FMoH is responsible for the collection and analysis of morbidity and mortality data only, supplied by each RHBs on a monthly or quarterly basis.

Formally the DHOs are free to customize HIS according to their needs, but this is not happening currently due to the legacy of centralised control, the interference and influence mainly from vertical program managers and lack of confidence by the lower-level health managers to customize HIS. On the other hand, the health workers and managers at health facility level, who are actually the original sources of the information generated and the actual users of most of the data collection instruments, do not have any formal authority to customize data elements or reporting formats according to their needs.

During the study it was observed that the data elements in different registration books were hand written and lacked uniformity across the different facilities. This is a clear indication of lack of standardisation in the type of data collected across health facilities. Shortage or lack of reporting forms is also cited as a serious problem to health service providers. Most of them indicated that:

'... We are sometimes forced to prepare the reporting forms manually using pen and paper to deal with the shortages of forms. This is really time consuming and tiresome'.

It was also observed that the data elements in the different reporting formats were redundant and not based on local needs and requirements. As one health worker pointed out:

'... repetition of items is common in different forms. For example, data elements included in MCH (such as Antenatal service, first visit, delivery service etc.) are also reported in the monthly health facility reporting format for health services. EPI, surveillance and Morbidity and Mortality forms also have many redundant items which are also reported in other forms'.

Most of the health workers and managers at health facilities visited demanded for more local flexibility and more local control on data collection instruments. Due to inflexibility of the existing reporting formats, users have problems to add new data items that they need but not included in the existing forms. For example, as one respondent indicated:

'... the existing forms could not be used for computation of basic indicators since they lack data elements for the target population of the specific health programme. And it is not possible to include the missing item(s) by the lower levels without the approval of the higher levels, especially the different vertical programmes'.

Although most managers agree on the importance of using information from HIS for planning and decision-making, so far, due to inadequacy and incompleteness of the data reported from lower levels, managers at different levels indicated that they do not often use the information from HIS. However, there are exceptions, for example, in Amhara it has been noticed that the data collected from health facilities are summarised and used to make some decisions at local levels such as: to identify the top 10 diseases in the district and plan interventions, to evaluate the performance of HFs in the district compared to their plans, and to follow-up resource consumptions.

At the lower levels (health facilities), when asked about whether or not they use the data they generated for some action and decision-making purposes, most of them reported that they just sent the reports to the respective higher levels and vertical programmes. They only keep the copy of monthly reports to compile quarterly or annual reports. Some indicated that using the monthly reports, they calculate percentages of what has been performed in relation to the plan they had on quarterly or annual basis. Only very few of them indicated as they convert percentages into graphs and charts.

THE LINK BETWEEN THE HIS AND DECENTRALISATION

The effective operation of decentralised health system and a well-working HIS are inextricably linked. Adequate local decision-making requires reliable information from the HIS. However, as our study has shown, a well-working HIS requires decentralisation of authority over HIS and development of local capacity to adapt it to local needs. However, if HIS is inflexible, as is the case today, the HIS cannot support the drive towards

decentralised capture, local analysis and local use of information. Consequently, the HIS fails to support, and actually undermines the wished-for transformation of the health sector towards decentralisation.

We claim that rigid standards as well as the centralised and inflexible nature of HIS are a significant explanation for the problems described above. For example, the emergence of multiple, programme-specific systems is partly due to the inflexibility of the general, national HIS, since it is practically difficult to incorporate data sets of existing and newly emerged vertical programmes in the existing system. It has been customary to organise the design and development as centrally guided processes. This has the effect that the focus will be on central needs and concerns, and will lead to alienation of the end users at the local level. In most countries both the specific data elements, data sets, data collection tools (such as forms and register books), reporting instruments (report formats) and the HIS software has been designed without involvement of the actual users. In several developing countries the HIS software is not even under control by the MoH, but by external software companies (Kimaro and Nhampossa, 2005).

The explicit aims of these centrally focused approaches have been *standardisation* and *uniformity*. We claim that *decentralisation* and *flexibility* should be an equally important design goal for a HIS. Users at all administrative levels need to be able to make decision in order to have tools and routines that are appropriate for local information needs. In addition, there should be a built-in possibility to change the HIS with new emerging diseases, when new treatments become available, or when special needs arise. In addition to change flexibility, a well-working HIS should be flexible enough to be possible to implement in conditions with very different infrastructural resources. A one-size-fits-all system is not adequate.

The reader may ask: Will not local autonomy and flexibility in defining data elements and forms lead to utter chaos and undermine the whole HIS? Are there any examples of this actually working? There are several examples of countries that allow such flexibility in their health care system. Probably the best known is South Africa, which has defined an Essential Data Set, a number of data elements and indicators that are required to collect and report to the MoH from across the country. Each province and each region has a possibility to add its own data elements to that data set. Similarly, each district and each health facility within that district may decide which data elements to collect. Data collection tools and reports will thus be different in different locations, however, standardised among those who report to the same entity. This hierarchy of standards (Braa and Hedberg, 2002) aims at reducing the amount of reported information to a minimum, and to facilitate decentralised use of information. The design of the Essential Data Set in South Africa was based upon two key principles; limiting the routine reporting needs to a set of 100–150 data elements, which allowed calculation of 80–120 indicators and integrating the needs of vertical programmes (Shaw, 2005). What is interesting in this case is that this data set did not emerge from decisions taken at the central level. It came from activities in a remote district north in the Eastern Cape Province, Ukhahlamba district. In a post-apartheid effort to improve the health services, the district management team evaluated the services they were providing and identified data elements and indicators that would help them monitor them. During the next 8 years, these changes were spreading to other districts, to the region and then the province. In June 2002, a national workshop adopted the Essential Data Set for the whole country (Shaw, 2005), thus the dataset that was developed in a remote location came to be accepted as the national standard. Shaw (2005) furthermore exemplifies the effects that the flexibility in the HIS had on the quality of health service provision. By registering not just ‘first antenatal visit’ but splitting it into two elements—‘first antenatal visit within 20 weeks of pregnancy’ and ‘first antenatal visit after 20 weeks of pregnancy’ the local team was able to verify their gut feeling that antenatal care in the first trimester was very low, and to target their services accordingly. Other examples² include the modification of the local HIS in some Eastern Cape districts in the border area. They started to collect and analyse data on how many of the patients that came from outside the official catchment area of the districts. Then they were able to assess the magnitude of cross-border flow of patients and thus had stronger arguments to defend the costs associated with running the services. In addition, a region or district may decide to break up data according to sex (or other locally relevant categories) to get sense of equity in the service provision. These kinds of

²Personal communication from Vincent P. Shaw, 8 October 2007.

policy-related needs for specific information may be temporary rather than permanent, and may be relevant only on a level below the national level. Incorporating them into the long-term, national standards are thus not always feasible.

OUR PRACTICAL RECOMMENDATIONS

Decentralisation of health delivery services to the district level 'generates new information needs and calls for an in-depth restructuring of information systems with new requirements for collecting, processing, analysing and disseminating data' (WHO, 2004; p. 43). The goal of the decentralised HIS is to meet the needs of the local level by granting them some degree of local control of the HIS. Any information system in use comprises a lot of different entities. Data elements, data sets and indicators are linked to the tools for data collection that are used, and these tools are again linked to which information can be (and is) used locally and what is reported to higher levels. Equally significant elements in the HIS are the procedures, guidelines, regulations that specify how and when to collect, calculate and report, as well as software tools (Woldeyohannes and Molla, 2005). Below we discuss concretely for which of these elements there is a need for change.

Report generation (type and frequency)

In the existing system (computer and manual based), there are fixed reports and reporting formats. Local flexibility is required in report generation, for example, in terms of frequency (e.g. weekly, monthly and quarterly) of reports to achieve better control over dynamic situations, or easier validation of data. Different types of health facilities (e.g. hospitals, health centres and dispensaries) may benefit from customized reporting forms, not just using one format for all. In addition, there is a need to allow local management to generate a variety of different analytic reports, for example, using graphical and visual aids to present local information in a way that facilitates local decision-making.

Deciding on data elements

Adding or deleting of data elements should be possible according to local needs. Some health problems are specific to a geographic area, and should thus not be included in the national forms. The concept of a hierarchy of standards (Braa and Hedberg, 2002), that is, minimum or essential data sets defined at the national level allows for this flexibility. This flexibility leads on to the next point.

Flexibility to define and generate appropriate data collection and reporting tools

Decentralised design and printing of tools for data collection should be facilitated. Currently data collection and reporting tools are designed centrally in a one-size-fits-all manner. Not only is this approach a waste of resources, it also encounters severe logistics problems. If data collection and reporting tools (standardised or customized) could be printed locally, the quality of data would increase, as local ad-hoc solution (such as use of exercise books) would not be necessary.

Ownership to and flexibility of the software

The formal ownership to software, both source code and executable code, should rest with stakeholders within the sector. The software should be flexible enough to accommodate changes at every level in the administrative hierarchy. That means that users should be able to include the data elements and generate the amount and types of report that they wish. Packaged and finished systems will not give the sufficient flexibility.³

³Such a software tool is freely available through the HISP project that the authors are affiliated with. The DHIS, the District Health Information System is also the software used as the national standard in South Africa. Software, manuals etc. can be accessed at www.hisp.info

CONCLUDING REMARKS

Health sector reforms through decentralisation imply transfer of authority of decision-making and creation of local capacity to manage and support not only health services but also the HIS. However, there is a need to redesign the existing historical top down and centralised HIS in order to make it locally relevant and appropriately decentralised. We argue that the control and coordination of a decentralised HIS is to be delegated to the district administration, thus providing them with a degree of autonomy over various aspects of HIS including budgets and the use of resources. We acknowledge the complexity of achieving a thorough-going decentralisation, and do not believe that a locally flexible computer systems is a stand-alone solution. Capacity building, enhancing the incentive structures, establishing transparency mechanisms etc. are all tasks belonging to what amount to significant institutional and cultural reforms. Our point in this article is that also the concrete tools for doing the decentralised work matter in achieving decentralisation. Users at all administrative levels need to be provided with appropriate skills and capabilities to collect and use information for action. Moreover, the user should be able to change the tools and routines to cater for local information/system needs without affecting the set standards and needs of other systems and levels. In order to achieve these aims, appropriate authority, capacity and decentralised allocation of resources for HIS must also be developed. The mindshift that is necessary for starting locally targeted action based on tailoring the HIS, is not to be expected immediately after installing a flexible, computerised HIS. It will probably take years to emerge, based on familiarity with the technology's capacities, knowledge about the possibilities etc. It also hinges on the practicalities around HIS in the local setting, such as adequate staffing. For example, each district level must have a dedicated unit or office that is handling and coordinating information. In addition, without the possibility for generating data collection tools locally (i.e. to print modified paper forms), any change of the computerised system is futile. However, and this is our main point in this article, in order for each level to exercise its required control, the HIS must be flexible enough to cater for various information needs over space and time.

Our last remark concerns the need to include local flexibility as a central goal in ongoing national HIS redesign processes. If it is true that 'the most powerful of these [obstacles to decentralisation] seem to grow from the persistence of actors at the centre in trying to retain authority and resources' (Wunsch, 2001: 277) then the ongoing HIS redesign efforts is a crucial area where the fate of decentralisation of health care is decided. The standardised national system can be derived from the combination of both bottom-up and top-down analyses. Negotiation needs to balance the needs of each level and of the various vertical health programmes. The central-level's needs for standardisation and uniformity needs to be balanced against the local-level's needs for flexibility. If this is to be achieved in the product (the HIS), the process must be conducted accordingly, that is, with real participation. It is crucial that redesign processes of HISs should include individuals from the district and health facility level, who are the primary users and beneficiaries of a system and who work in very different environments, with other needs and resources than centrally located managers.

REFERENCES

- Adamolekun L. 1991. Decentralization policies: problems and perspectives. *Asian Journal of Public Administration* **13**(1): 67–92.
- Bijlmakers L., Hingora A., Swai G. 2004. Demand Driven District Capacity Building: Preparation of Modalities. Consultancy Report, Partners in International health, Tanzania.
- Boerma TJ. 1991. *Health Information for Primary Health Care*. African Medical and Research Foundation: Kenya.
- Braa J, Blobel B. 2003. Strategies for developing health information systems in developing countries. In *WITFOR 2003 White Book*, Khakhar D (ed.). IFIP Press: Luxemburg; 175–219.
- Braa J, Hedberg C. 2002. The struggle for district-based health information systems in South Africa. *Information Society* **18**(2): 113–127.
- Braa J, Monteiro E, Sahay S. 2004. Networks of action: sustainable health information systems across developing countries. *MIS Quarterly* **28**(3): 337–362.
- Chilundo B, Aanestad M. 2004. Negotiating multiple rationalities in the process of integrating the information systems of disease-specific health programmes. *The Electronic Journal on Information Systems in Developing Countries* **20**(2): 1–28.
- Galvin M, Habib A. 2003. The Politics of decentralization and donor funding in South Africa's rural water sector. *Journal of Southern African Studies* **29**(4): 865–884.
- Görge, H, Kirsch-Woik T, Schmidt-Ehry B (eds). (2004). *The District Health System: Experiences and Prospects in Africa*. Manual for Public Health Practitioners. German Technical Cooperation. GTZ Series No.: 276, ISBN 3-88085-535-8. Available at <http://www.afronets.org/files/district-health-en.pdf>

- Harpham T, Few R. 2002. The Dar es Salaam Urban Health Project, Tanzania: a multi-dimensional evaluation. *Journal of Public Health Medicine* **24**(2): 112–119.
- Health Metrics Network (HMN). 2007. *Framework and Standards for Country Health Information Systems*, 2nd edition. WHO: Geneva, Switzerland.
- Health Research for Action (HERA). 2000. Review of the Health Management Information System. Final Report. Volume I of II, Ministry of Health, Tanzania. Unpublished document.
- Health Sector Development Program (HSDP) III. 2005. Federal Ministry of Health (FMOH). Addis Ababa, Ethiopia.
- Hutchinson P. 2002. Decentralization in Tanzania: The View of District Health Management Team. Report WP-02-48. MEASURE Evaluation: Chapel Hill, North Carolina.
- Kimaro HC. 2006. Strategies for developing human resource capacity to support sustainability of ICT based health information systems: a case study from Tanzania. *The Electronic Journal of Information Systems in Developing Countries* **26**(2): 1–23.
- Kimaro HC, Nhampossa JL. 2005. Analyzing the problem of unsustainable health information systems in less-developed economies: case studies from Tanzania and Mozambique. *Information Technology for Development* **11**(3): 273–298.
- Kopoka PA. 2000. Provision of Health Services in Tanzania in the Twenty-First Century: Lessons From the Past. Paper Presented at a Workshop on Economic Policy Environment in Tanzania in the Twenty-First Century: Lessons From the Nyerere Legacy Held From 30th March to 31st March 2000 in Dar-es-Salaam. Retrieved April 15, 2006, From <http://www.fiuc.org/iaup/ssi/PDF-doc/IDS-doc/nyerere.pdf>
- Lippeveld T, Sauerborn R, Bodart T (eds). 2000. *Design and Implementation of Health Information Systems*. WHO: Geneva.
- Litvack J, Ahmed J, Bird R. 1998. *Rethinking Decentralization in Developing Countries. Poverty Reduction and Economic Management Network*. The World Bank: Washington, DC.
- Ministry of Health (MoH). 1993. Health Management Information System Implementation Plan for 1993–1996. Unpublished Report. Dar es Salaam, Tanzania.
- Mliga GR. 2003. Decentralization and the Quality of Health Care in Tanzania. In *Africa's Challenging Markets for Health and Veterinary Services: The New Institutional Issues*. University of California International and Area Studies Digital Collection **5**(8).
- Mosse E, Sahay S. 2003. Counter Networks, Communication and Health Information Systems: A case study From Mozambique. In *Proceedings of the IFIP TC8 & TC9/WG 8.2+9.4 Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization*, Korpela M, Montealegre R, Poulymenakou A (eds). Kluwer: Athens, Greece.
- Mwangu MA. 2003. Enhancing District Health Planning and Management in Tanzania: A Social Political Analysis of the Role of the Health Management Tanzania Health Research. Doctoral Thesis, University of Dar es Salaam, Tanzania.
- Olowu D. 1989. Local institutes and development: the Africa experience. *Canadian Journal of Africa Studies* **23**(2): 201–231.
- Olowu D. 2003. Local institutional and political structures and processes: recent experience in Africa. *Public Administration and Development* **23**: 41–52.
- Opit LJ. 1987. How should information on health care be generated and used? *World Health Forum* **8**: 409–438.
- Piotti B, Chilundo B, Sahay S. 2006. An Institutional perspective on health sector reforms and the process of reforming health information systems: case study from Mozambique. *Journal of Applied Behavioral Science* **42**: 91–109.
- Rubona JJ. 2001. Routine health information systems that operate in Tanzania. In *The RHINO Workshop on Issues and Innovation in Routine Health Information in Developing Countries*. The Bolger Centre, MEASURE Evaluation: USA; 183–193.
- Sandiford P, Annet H, Cibulskis R. 1992. What can information systems do for primary health care? An international perspective. *Social Science and Medicine* **34**(10): 1077–1087.
- Shaw V. 2005. Health information system reform in South Africa: developing an essential data set. *Bulletin of the World Health Organization* **83**: 632–639.
- UNICEF. 1990. *Women and Children in Tanzania. A Situation Analysis*. United Nations Children's Fund: Dar es Salaam.
- Woldeyohannes B, Molla S. 2005. Challenges and Approaches to Scaling and Standardizing Health Information Infrastructure in Developing Countries: Case studies from Ethiopia. Master Thesis, University of Oslo, Department of Informatics.
- World Health Organization (WHO). 1978. The declaration of Alma-Ata, International Conference on Primary Health Care. Alma-Ata, USSR, 6–12 September 1978.
- World Health Organization (WHO). 1994. Information Support for New Public Health Action at the District Level. Report of a WHO Expert Committee. WHO Technical Report Series, No. 845 WHO: Geneva; 1–31.
- World Health Organization (WHO). 2004. World Report on Knowledge for Better Health: Strengthening Health Systems. Geneva.
- World Health Report. 2004. *Changing History*. World Health Organization: Geneva.
- Wunsch JS. 2001. Decentralization, Local Governance and Recentralization in Africa. *Public Administration and Development* **21**: 277–288.

APPNDIX IV

Mengiste, Shegaw A. (2009). Analysing the challenges of IS implemntation in public health institutions of a developing country: The need for flexible startegies. *Journal of health informatics in Developing Countries* (Under Review).

Analysing the challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies.

Shegaw Anagaw Mengiste

Journal of Health Informatics in developing Countries (revised Version).

Abstract

This paper explores the challenges of introducing computer-based health information systems in the context of the Ethiopian public health care system. Drawing empirical examples from the process of introducing computer-based health information system(HIS) in two regional states (Amhara and Benishangul-Gumuz) of Ethiopia, this paper analyses the socio-technical challenges influencing the transition towards a new computerised system and suggested the importance of developing context-sensitive strategies to tackle different challenges in different contexts. Building on the notions of installed base and cultivation the paper examines the socio-technical issues and factors that influenced the process of developing, customizing, and implementing computerised HIS in different settings. The findings of this paper revealed that contextual differences in terms of access to infrastructural resources, availability of adequate and qualified manpower, and managerial commitment and support would significantly influence the implementation process. I argue that, such context-sensitive challenges need to be dealt through flexible strategies that took in to account the specific context. In this paper, four different flexible strategies: the strategy of gateways, top-down vs bottom-up approaches, flexible essential data sets and clustering have been identified as being useful in implementing computer-based systems in different settings of the Ethiopian public health care system.

Key words: Health Information systems, implementation, flexible strategies, Ethiopian health care system.

INTRODUCTION

This paper explores the challenges of introducing computer-based health information systems in the context of the Ethiopian public health care system. Drawing empirical examples from the process of introducing computer-based health information systems (HIS) in two regional states (Amhara and Benishangul-Gumuz) of Ethiopia, the paper analyses the challenges influencing the transition towards the new system and suggests the importance of developing context-sensitive strategies to tackle different challenges in different contexts. The study has been carried out as part of the global Health Information System program (HISP), which is a global research and development initiative working on the design, development and

implementation of computerized HIS in various developing countries including Ethiopia (see Braa & Hedberg 2002; Braa et al. 2004; Braa et al. 2007a).

The importance of strengthening the routine health information systems (HISs) has been well recognized by international organizations (Such as WHO, UNDP), aid agencies (such as World Bank) and national governments as one approach to support the public health reform initiatives of developing countries. More specifically, the Alma-Ata declaration of 1978 set out a new approach leading to the development of health information systems most commonly seen in many developing countries today. The Alma-Ata (1978) conference emphasised on the importance of well-designed and well-functioning routine health management information system as an essential mechanism to achieve the vision of improved health services delivery in developing countries (WHO 1994) by allowing policy makers, managers and health workers to “identify problems and needs, track progress, evaluate the impact of interventions and make evidence-based decisions on health policy, programme design and resource allocation” (WHO-HMN 2007, pp. 6).

Recognizing the importance of a strengthening existing fragmented and unstructured health information systems for better health care delivery and management; there has been tremendous initiatives in developing countries to reform existing fragmented and paper-based routine health information systems, an “initiative spurred in large part by technological advances, and the interest these advances have generated in the health sector” (Vital Wave Consulting 2009, pp. 14). For example, there is growing recognition that ICT can replace traditional routine paper-based HISs with flexible electronic means and could bring significant cost reduction and effectiveness in terms of timely delivery of health care services in developing countries (see Mackenzie 1999, Braa and Hedberg 2002; Braa et al. 2004; Braa et al. 2007a). The introduction of information and communication technologies has also been promoted both to automate and make existing paper-based routine data collection and reporting system efficient, such as to make different patterns (e.g. mortality, immunization, fertility etc) visible that are often invisible with manual systems. Technology can also improve data collection quality, accuracy and timeliness. Electronic systems also make reporting potentially much more flexible and efficient by allowing data to be analysed at the level where the data is collected as well as the levels above it. On the contrary, in paper-based systems data is collected and compiled manually at each site where the data is collected, a process that hinders managers and decision makers at higher levels of the hierarchy from viewing the disaggregated data coming from lower levels of the system (Braa et al. 2001).

To tap the potentials of ICT based technologies and tools, various developing countries including Ethiopia embarked in ICT based initiative to transform their existing paper-based data health management information systems. For example, Alvarez (2004) reported the initiatives of the government of Ecuador in collaboration with donor agencies (such as IDA), to decentralise and modernize the health management, including the HIS, in health districts of the country to support primary health care services. There are also similar reform initiatives to decentralize public health care delivery system and strengthen the existing paper-based HIS through ICT in various African countries including South Africa (Braa & Hedberg 2002), Mozambique (Nhampossa 2006; Mosse 2005), Tanzania (Kimaro 2006; Lungo 2008; Iqirah 2008), Ethiopia (Mengiste 2005; Bishaw 2008) Nigeria (Shaw, Mengiste et al. 2007) under the framework of HISP in collaboration with other international organizations such as WHO and regional and national governments (Braa et al. 2004; Braa et al. 2007a).

However, introducing such ICT based initiatives to transform existing paper-based data collection tools and systems in public health institutions of developing countries is a difficult process of change often fraught with several context-sensitive challenges and problems including: lack of adequate resources (such as poor financial resources and uneven infrastructural development) (AbouZahr 2005; Mosse and Sahay 2003); inadequate skills and knowledge at a local level to handle new systems and technologies (Kimaro & Nhampossa 2005); fragmented and uncoordinated organizational structure and heterogeneity of stakeholders (Chilundo & Aanestad 2004); and political and bureaucratic constraints (Heeks 2002; Avgerou & Walsham 2002; Mosse and Sahay 2003). For instance, the public health care system in Ethiopia is characterised by differences across regions and between districts and zones within a region in terms of existing HISs (paper-based, DHIS, and statistical tools such as EpiInfo), uneven infrastructure development (such as access to computers, internet connectivity, availability of telephone & electricity), differences in geographic size (large and small), differences in human capacity and competency (both from the IS and health domains), and varied organizational and managerial commitment and support. In such contexts, it is appropriate to get a deeper understanding of the contextual challenges at a local level and formulate context-sensitive strategies. This paper, therefore, aims to explore the different contextual challenges and choices of action adopted in introducing change to the existing paper-based health management information systems (HMIS) in two regional states of Ethiopia (Amhara and Benishangul-Gumuz), and draw lessons and strategies for IS implementation in the context of developing countries.

More specifically, this paper would like to address the following research questions:

- What are the challenges that influence the process of making a transition from paper to digital HIS in different settings of the Ethiopian public health care system?
- What strategies could be formulated to deal with the challenges in different settings and contexts?

This paper is organized as follows. The next section provides the conceptual framework by conceptualizing HIS development and implementation as cultivation of the installed base. In section three, the research setting, research approach and data collection methods employed are presented. Section four describes the case study which is related with the process of introducing computer-based health information software (DHIS) in two regional states of Ethiopia. Section five presents analysis and discussion of findings by emphasising the need for flexible strategies. The last section provides concluding remarks.

2 Conceptual framework: the notions of cultivation and installed base

In recent years, proponents of the Information Infrastructure perspective (for example, Hanseth & Monteiro 2004; Hanseth & Aanestad 2003; Hanseth & Lyytinen 2004) use the cultivation approach as analytical tool to explore socio-technical processes in different contexts of introducing large scale and complex information systems. In this paper, on concepts of cultivation and installed base from information infrastructure (II) theory (Hanseth et al. 1996; Hanseth and Lyytinen 2004; Hanseth and Monteiro 1998) as analytical lens to explore the challenges of introducing computer-based health information systems (HISs) in the context of the Ethiopian public health care system.

Traditional IS design strategy assumes that systems can be developed from scratch, as isolated and stand-alone applications with defined goals, start and ending times rather than as events changing overtime through ongoing process (Orlikowski 1996). However, contemporary approaches treat design and change not as traditional IS but as Information Infrastructure (II) (Hanseth et al. 1996). The II perspective which seeks to analyse systems as heterogeneous inter-connected socio-technical networks (Hanseth and Monteiro 1997, 1998) is used as an appropriate analytical tool to understand the challenges of introducing change when there are multiple socio-technical factors influencing the change process. The current trend of viewing ISs as Information Infrastructures (see Hanseth 2002; Hanseth and Monteiro 1998) is the result of acknowledging the increasing complexity in terms of technical as well as social entities (see Jacucci et al. 2002) in the process of developing and implementing ISs. For example, socio-technical factors (such as geography, history, legacy systems, technical support and competency, political commitment and support, poor infrastructure and other organizational issues) that are embedded in the broader context significantly influences the process of change and implementation of technical artefacts/software, best practices, standards, experiences and knowledge. Hanseth (2002) in addressing how an Information Infrastructure is changed argued that:

“the whole infrastructure can’t be changed instantly- the new has to be connected to the old. The new version of the infrastructure or artifact must be designed in a way making the old and the new linked together and interoperable in one way or another. In this way, the old- the installed base- heavily influences how the new can be designed” (no page).

Strategies for creating and managing such processes are conceptualized as cultivation of the installed base (Hanseth 2002). The process of introducing change to large and complex ISs, therefore, requires taking in to account the existing installed base of work practices, human resource competency, systems and standards, technological artifacts, available resources, organizational commitment and support.

The concept of installed base refers to what already exists (technical and non-technical) in terms of the existing standards, diverse software versions, infrastructure (both physical and digital), human resource, work routines, and organizational structures. As such, any process of designing, developing and implementing an information infrastructure cannot be started from the scratch; it should rather take into account existing systems, procedures, processes and standards while trying to introduce new changes. As such the installed base influences and shapes the evolution and implementation of the new system (Nilson, Grisot and Aanestad 2005). However, the installed base cannot be changed instantly because of its sheer size and degree of embeddedness and its change heavily influences how the new II can be designed (Hanseth and Monteiro 1998). Thus, an II is built through extensions and improvements of what exists - never from scratch. Changes have to be linked to the existing installed base, either as extensions, revisions or replacements. Because of its nature, II evolve beyond a single management or actor’s control (Ciborra et al. 2000; Hanseth et al. 2001; Aanestad 2002).

The notion of cultivation (Dahlbom & Janlert 1997; Hanseth and Monteiro 1997, 1998) considers the design and development of II to be a long-term incremental strategy, extending and growing upon an existing installed base rather than to trying and radically changing the installed base (Braa et al. 2007a; Hanseth and Monteiro 1997). The cultivation approach, instead of believing that it is possible to create without being restrained, believes that the appropriate thing to do is to be as sensible as possible of the existing situation and conditions of the part of reality. By doing so, unlike the designer, the cultivator learns how and when to intervene to change existing systems, structures, standards, process and work practices (Söderström. and Nordström

2005). As such, the Cultivation approach requires a prior analysis of the organisational, technological, social and political context of the already existing elements of the installed base (Hanseth and Monteiro 1998). With cultivation approach, it means that an II is never developed from scratch. When designing a new II, it will always be integrated into or replacing a part of earlier one (Braa et al. 2007a).

In this paper, therefore, the notions of installed base and cultivation are used as analytical tools to provide insight on how to deal with the challenges of introducing computerized HIS in public health care institutions of a developing country. More specifically, changing existing routine paper-based HIS which is currently in use at different levels of the public health care system in Ethiopia is a complex process that requires the actions, interactions and negotiations of several stakeholders (including health workers, managers, donor agencies, system analysts and developers). As such, the transition process requires careful assessment of existing installed bases and formulation of specific strategies on how to deal with diverse challenges in cultivating existing systems, tools, standards and work practices for different settings and contexts. To this end, this article investigated the challenges of making a transition in such complex setting based on empirical findings from the experiences of cultivating existing routine paper-based HIS in two regional states of Ethiopia.

3. Research Setting, Approach and Methods

3.1 Research Setting

This section describes the research setting and research strategy adopted. The empirical setting for this research is Ethiopia which is located in the north eastern part of Africa with a total area of 1.1 million km² and a total population of 73.2 million growing at a rate of 2.6% per year (CSA 2008). More than 85% of its population is living in rural areas, making Ethiopia one of the least urbanized countries in the world (HSDP III 2005/06-2009/10). Politically, Ethiopia introduced a federal structure since 1994 comprising of 9 National Regional States (NRS) and two city administrative states¹⁴. The regional states as well as the city governments are further divided into 65 zones, 624 ‘woredas’ (districts) and around 10,000 ‘kebeles’ (the lowest administrative bounties) (HSDP III, 2005/06-09/10).

The public health care system in Ethiopia comprises of the Federal Ministry of Health, Regional Health Bureaus, Zonal Health Departments, and Woreda Health Offices, with their respective health facilities – central referral (specialized) hospitals at the federal level, hospitals at regional, Zonal and district levels, and Health Centres, Health Stations, and Health Posts at district (woreda) levels. The health care system is largely underdeveloped and under resourced and as a result can only provide basic health services for about 60% of the population (HSDP III, 2005/06-09/10). Much of the rural population has no access to modern health care, leading to inability of the health care delivery systems to respond to the health needs of the people.

In Ethiopia, as per a report made by HSDP III (2005/06-09/10), lack of timeliness and completeness of HIS reporting remains a weakness, and such delays contribute to the failure (at all levels) to use data as the basis for informed decision-making in health care planning and management. Recognizing the weaknesses of existing routine paper-based system, there have been repeated efforts to reform HMIS in Ethiopia (WHO-HMN 2007). The government recognizes that an efficient HIS, would play a crucial role in successful implementation of national health sector development program’s strategic plan (WHO-HMN 2007).

¹⁴ *Tigray, Afar, Amhara, Oromia, Somalia, Benishangul-Gumuz, Southern Nations, Nationalities and Peoples Region (SNNPR), Gambella, and Harari*

As a result, both the federal government and regional states in collaboration with international organizations, donor agencies, and bilateral collaborations introduced several reform initiatives to improve the existing poor status of health management information systems at all levels. , Some of such reforms include: “standardization of procedures in data collection, analysis and reporting; selection of sector-wide and programmatic indicators with the involvement of stakeholders, design of simplified items (question) of the formats; and integrated and unified flow of information” (ibid, pp. 4-5). This research is an integral part of this reform process conducted with in the framework of the global HISP initiative which has been working on the design and development of computerized HIS in five regional states of Ethiopia and many developing countries in Africa and Asia (see Braa et al. 2004; Braa et al 2007a; Braa et al. 2007b, www.hisp.info; Sæbo and Titlestad 2003 for details about HISP activities in different countries).

HISP-Ethiopia has been initiated in 2003 as a collaborative project between departments of Information Science, Addis Ababa University and the University of Oslo, Informatics department. Furthermore, an agreement has also been reached between HISP and 5 regional health bureaus (i.e., Oromia, Amhara, Tigray, Benishangul-Gumuz, and Addis Ababa) to change existing routine paper-based HIS by adapting and implementing DHIS software; collaborate on the development of standardized essential data sets, reporting formats and indicators; and in building capacity through training of health workers and managers at different levels of each regional state. Up until HISP initiatives disbanded by the Federal Ministry of Health in 2007 in favour of an American-based consulting agency (John Snow Inc. (JSI)) to undertake all HMIS reform activities both at regional and national levels; HISP has been engaged in building local capacity of health workers and mangers as well as in adapting and implementing district-based health information software (DHIS) across the five pilot regions. For example, in Addis Ababa, the project had supported the full scale implementation of DHIS ver. 1.3 in 11 sub-cities, 5 hospitals and 23 larger health facilities of the regional health bureau that enabled electronic transmission of data from the lower to the upper levels to replace the paper-based reporting system. In Oromia, DHIS 1.3 has been implemented in 5 out of 25 zones and transition from DHIS 1.3 to DHIS 1.4 was undertaken at the time when HISP stopped its operation. In Amhara regional state DHIS 1.4 has been deployed in 11 zones and an effort was underway to scale the system to some selected pilot districts (woredas). In Benishangul, DHIS 1.3 has been piloted at regional health bureau and one zonal health office. In this paper, the challenges and strategies of changing existing routine paper-based HIS drawing on the experiences from HISP initiatives in Amhara and Benishangul-Gumuz regional states is provided.

3.2 Research Approach and Methods

This study employed a qualitative research approach, based in the interpretative tradition (Walsham, 1993), which seeks to understand complex social, technological and organizational issues related to the development, customization, and implementation of information systems in different contexts. As Walsham (1993) pointed out, interpretive research is "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham 1993, p. 4-5). The empirical data presented here was collected by the author who is an Ethiopian national and a member of the HISP-Ethiopia development and implementation team. As a member of the HISP-Ethiopia team, the author participated in conducting situational analysis, software customization, implementation, and capacity building activities in Amhara and Benishangul-Gumuz regional states since 2004. Apart from the knowledge that comes from different

sources during long term exposure in the project, the empirical material for this specific study was collected through semi-structured interviews, observation during meetings and workshops, and document analysis.

Interview:

Interviews were conducted with managers at regional, zonal and district levels, health workers, HMIS officers, and HISP-Ethiopia development and implementation team members. Questions asked during the interview sessions were open-ended and semi-structured. Questions were more specifically structured to reflect on the challenges of transforming existing paper-based HIS and the approaches and strategies adopted to deal with those challenges. Besides, an informal group discussion (during lunch and coffee sessions) with HISP-Ethiopia team members as well as managers, and health workers at regional and district levels was held frequently to get their opinion on different issues related to the problem of existing paper-based system, implication of the new system in changing work practices and the specific challenges encountered in making the transition. During each interview, notes were taken which was then summarised and rewritten by the researcher.

Participant Observation:

As a member of the HISP-Ethiopia team, I participated in meetings, discussions held with HISP-Ethiopia team members. The issues addressed in those meetings and discussions covered different topics including progress of the project, problems encountered by each team member in the customization process (understanding the technologies, capacity and skill gaps infrastructural problems including weak internet connectivity etc), duties and responsibilities of members, how to link the new system to earlier versions that are in use in different health care institutions of different regions. The issues raised and discussed during those meetings and discussions assisted me to gain an overall understanding on how the project was progressing, what were the impediments and challenges encountered in the development and customization process, and on the technical competency of the local team members

Besides, I also participated in workshops held both in Amhara and Benishangul-Gumuz regional states where health workers and managers from different public health institutions come together and discuss on issues of standards, indicators, reporting formats and the problems and challenges they encounter. This gave me an opportunity to get first hand information about the challenges and, approaches of improving the existing paper-based system. Besides, I was able to have personal and informal discussions with some participants to get their opinions on the potentials of introducing computerised system to improve their work practices.

Document Analysis:

Analysis of existing documents (both printed and electronic) was another source of information. The relevant documents included strategic plans (such as HSDP III, 2005/06-2009/10), reports, and formal “Memorandum of Understanding” documents with the involved partners. These documents were reviewed to gather contextual information regarding public health care practices, policies introduced and strategies adopted to deal with specific challenges and problems.

4. Case Description

The empirical basis of this article is a case study of the initiative of implementing computer-based health information system in the Ethiopian public health care system in the framework of

the global Health Information System Programme (HISP). Since its initial development and implementation in the public health care system of South Africa in 1998, several versions of DHIS software have been adapted and are at different stages of implementation in various countries in the South including Mozambique, Tanzania, Malawi, Botswana, Nigeria, Vietnam, India, and Ethiopia. This case study, therefore, focuses on the trajectory of adapting and implementing DHIS ver. 1.3 in Benishangul-Gumuz and 1.4 Amhara regional states. The case study gives emphasis on the contextual factors influencing the adaptation and implementation of the software, the strategies adopted and the lessons learned from the process.

4.1 Benishangul-Gumuz Regional State

Benishangul-Gumuz region is one of the nine regional states in Ethiopia, which is located in Western part of the country. The region is relatively small, covering 51,000 km², with the capital city Assosa located 687km from Addis Ababa. It is divided into 3 administrative zones, 19 woredas and 33 kebeles. According to the 2007 Population and Housing Census of Ethiopia, the total population of Benishangul-Gumuz region is 670, 847 which gives a population density of 9/Km² (Flatie et al. 2009). Parts of the region are seasonally inaccessible by road or air. The livelihood of nearly 95% of the population in the region is subsistence farming (Flatie et al. 2009). Although Benishangul-Gumuz regional state is endowed with potential natural resources and has a great development potential (Melkamu 2004); currently it is one of the remotest, and least developed regions in the country and remains food insecure (ibid). The socio-economic conditions and health and nutrition status of the communities are very poor; the prevalence of malaria in particular is very high. HIV/AIDS is on the increase and the status of education across the region is also poor and consequently the majority of people are illiterate (Melkamu 2004).

The public health care system in the region is characterized by poor structure and inefficient delivery of health services to the population. The region has high prevalence of communicable diseases like tuberculosis, malaria, and intestinal parasitosis. The infant and under five mortality rate for the region is 84/1000 and 157/1000 live births respectively (FMoH 2006). The region has 2 hospitals, 15 health centers, and 88 health posts of which 1 hospital, 3 health centers and 44 health posts are located in Assosa zone (where Assosa is the regional capital) (ibid). According to a report by the Federal Ministry of Health (FMoH, 2006), the health services coverage in the region is about 55% of the population and the health services utilization rate is very low. This is mainly due to the fact that actual health service delivery service utilization is influenced by other factors such as transport availability, level of qualification of health workers and distribution of the health facilities and availability of adequate equipments and technologies in health facilities (Melkamu 2004).

4.1.1 Findings of situational Analysis in the region

Situational analysis conducted by HISP-Ethiopia team members (including the author of this paper) to assess the status of existing HIS, infrastructural (including digital and physical), and human resource related issues revealed that existing HIS is highly fragmented at all levels and characterized by poor infrastructure and inadequate manpower to handle the system. The following sub-sections, therefore, provide findings of the situational analysis on how existing HIS operates; infrastructural and human resource challenges and the strategies adopted by the regional health bureau in collaboration with HISP to curb the challenges (see Mengiste 2005 for details of the findings of the situational analysis).

Findings on Existing HIS in the region:

Structurally, the regional planning and programming unit is responsible for coordinating and managing the regional HIS in collaboration with zonal and district health offices. However, this office lacks adequate resources including skilled manpower, financial and material resources and HIS infrastructure (including adequate computers, access to internet and other communication devices) to spearhead the aspiration of the regional health bureau in transforming existing fragmented routine paper-based HIS into a system that supports health care delivery by making essential health data for planning, implementation and evaluation of health programs and services in the region.

The existing paper-based HIS is also highly fragmented. This problem is exacerbated by the continual and persistent demand of vertical programs (such as MCH, HIV/AIDS, Malaria) to maintain their own independent reporting systems. This lack of integration impedes the ability of leveraging data from multiple sources in making informed decision on disease patterns, immunization coverage, outbreak of potential epidemics etc. It also put much pressure on health workers at lower levels by forcing them to compile different reports for different programs. A nurse in one of the health facilities visited in the region expressed her frustration as follows:

“we often spent many hours every week compiling several forms for different health programs and yet we do not practically see the impact of the data we are reporting in improving health care delivery in our community or district.”

In terms of data collection and analysis, routine health data is collected using registers and paper forms at local community and facility levels from which it is compiled and reported to district health offices on monthly or quarterly basis. Each district again will aggregate the reports of each health facility in each respective district and send it to zonal health offices. The zonal health offices will compile reports for all districts in the zone and send reports to the regional health bureau. The planning and programming office at the regional health bureau, then aggregates the data from all zones and make some analysis on disease patterns, potential outbreak of epidemics and coverage of health services in each zone and make intervention when needed. Health workers and managers interviewed indicated that most of their time is spent in data collection; compilation and preparing different reports to different health programs and to the regional health bureau (see Mengiste 2005 for details). Regarding the importance of the data they collected and reported to higher levels, respondents pointed out that they don't see any value on the data in changing their day to day work practices or in improving the health delivery system. The respondents view the routine data collection process as a duty imposed by higher levels, and they undertake the data collection just because they are required to do so.

Findings on existing Infrastructure:

As a newly established regional state, the region also suffers from inadequate infrastructural and logistical constraints in terms of access to transport and communication facilities and technologies. Poor physical and digital (such as access to internet, computers, telephone roads, and electricity) infrastructure in the region is an impediment for many socio-economic development initiatives in the region (Melkamu 2004). For example, two of the three zones (Kemashi and Metekel) do not have transportation access during rainy seasons to reach to the capital of the region (Assosa) (see Mengiste 2005; Melkamu 2004). With regard to computers and access to internet, the situational analysis revealed that there are computers at different departments of the regional health bureau, but without internet connectivity. At zonal and district levels, all but Assosa zonal health office had no access to computers. Electricity is a problem in

the region, only the regional capital (Assosa) gets power from the central government. Telecommunication and postal services are also at their lowest level in the region. For example, there are only two digital telephone stations in the region one at Assosa town and the other at Pawe. The other zones and districts have only radio communication facilities. This lack of communication and road infrastructure severely affected the possibility of establishing health and education services and distribution of goods and services to the rural population by hindering the flow of resources, facilities and information.

Findings on Existing Human resource:

The empirical findings of this study revealed that lack of skilled and trained manpower with deep knowledge of public health, competency on data collection, analysis, indicator calculation contributes for poor performance of existing HIS and slow pace of introducing change to the existing paper-based HIS.

The human resource challenge is further exacerbated by frequent turnover of existing manpower seeking for better pay and conducive working environment. Most health workers (including medical doctors and nurses) join non governmental organizations working at national and international levels. For example two of our champions (the head of the regional health bureau and maternal and child health coordinator, both of whom are medical doctors) who have exerted so much effort to change the existing fragmented and unstructured data collection and reporting system in the region, end up in joining international NGOs working in Addis Ababa.

Highly bureaucratic recruitment procedures as well low salary scale of the public service system is also another impediment in recruiting and retaining new work force to handle HMIS related activities in the region. The situational analysis also revealed that most of the health workers and managers at district, zonal and regional levels do not have any background or training on computers and associated technologies and tools. For example, the head of the planning and programming unit (who is also coordinating HMIS activities in the region) informed me that:

“ my background is on statistics and I didn’t get any training on computers. With my personal effort I can use some Microsoft office applications such as MS-Word and MS-Excel”.

4.1.2 The way forward: devise context Sensitive strategies

The findings of the empirical investigation ensured that the only way forward to deal with all the challenges of fragmented HIS, inadequate human resource and poor infrastructural situation in the region is to devise context-sensitive strategies that took into account the reality on the ground at a local level. To this end, the HISP team working in the region in collaboration with the officials of the regional health bureau and heads of vertical programs devised strategies to tackle the challenges encountered in improving the existing paper-based HIS in the region. The following sub-sections, therefore, provide an overview of the approaches and strategies formulated.

Dealing with existing fragmented HIS:

The overall HISP approach and strategy of user participation and involvement at all phases of software customization and data standardization has been used as an approach to deal with top-down, centralized and fragmented HIS. As Braa et al. (2004) indicated, one of the essential issues that contribute for development and implementation of sustainable HIS at a local level is shaping and adapting the system to a given context, cultivate local learning processes and institutionalizing them at a local level. Similarly, to deal with the fragmented and unstructured data collection and reporting system, an agreement was reached between

HISP and the regional health bureau to establish an HIS review team comprising of representatives from health workers, managers (from woreda, Zone and regional offices), vertical programs to undertake the standardization of the regional data sets and reporting formats, developing health indicators for the region, and customizing DHIS to cater to the needs of the regional health bureau. Though the overall process of data standardization and its deployment to different levels was fraught with tensions and conflicts mainly emanated from diverse requirements and demands of vertical health programs (due to their interest to maintain their data items), inadequate skilled manpower with basic knowledge on health data analysis, and poor access to resources (including financial and infrastructural); HISP has devised different strategies to tackle the challenges and to make its initiative in the region more sustainable. Some of the strategies include:

- Enhance a bottom-up, incremental and participatory approach in introducing change to existing systems, work practices and standards. This approach empowers health workers and managers at lower levels by creating a sense of ownership to the system and giving opportunity to understand and question the value and importance of the data they collect and report. In Benishangul-Gumuz, this approach has been adopted during the process of developing essential datasets and standardizing data collection and reporting forms.
- Enhance interaction, negotiation and mutual learning through workshops and group meetings organized at different stages of the standardization process.
- Address the challenges of fragmentation and lack of good quality data by developing the regional essential data sets and reporting formats.
- Introduce the notion of flexible standards across different levels (see Braa and Hedberg 2002; Braa et al. 2004) that allows a hierarchy of information needs whereby local users at health facility and district levels can expand the essential data sets to address their specific needs, while still reporting on the essential data required at higher levels.

Dealing with infrastructure related challenges:

The existing poor digital infrastructure in the region (particularly in terms of telephone, computer, fax and internet) significantly affected the exchange of crucial information, for example, on disease outbreaks, or delivery of vital equipments and medicine at the right time. Although addressing the existing infrastructural challenges of the region were beyond the goal and capacity of the HISP initiative in the region; several strategies were devised to cope with these challenges in the process of implementing DHIS in the region. The strategies were developed by HISP team members in consultation with the officials of the regional health bureau. For example, to deal with the problem of computers at zonal and district levels, international organizations (such as WHO, UNICEF, USAID) that have been working in the region were contacted to donate used computers and an encouraging result had been achieved. Due to this approach about 8 used computers were delivered to the regional health bureau. The then HISP facilitator in the region played significant role in contacting donor agencies and following-up the process. Besides, by consolidating and integrating the existing fragmented data collection and reporting formats, the number of reporting forms to be generated had been reduced which in turn reduce the work load of health workers and allow reports to be compiled and sent from one central location (where there is a generator and computer access) for a cluster of health facilities. In Benishangul-Gumuz, though initial efforts to analyze reports from a cluster of health facilities in Assosa zone brought encouraging results; the strategy was not fully tested at different zones and districts. My view is that, the clustering approach should be further explored in other resource constrained settings to better understand the strategy.

Dealing with human resource challenges:

The importance of building the capacity and competency of existing manpower at different levels of the public health care system had been emphasized as a strategy to deal with the existing poor human resource status (both in terms of access and skills) in the region. To this end, HISP-Ethiopia team members in collaboration with the regional health bureau devised different capacity building strategies. The key intervention strategies devised include: allow participatory adaptation and implementation of DHIS software to facilitate inter-disciplinary learning; organize capacity building programs at different levels to enhance to competency and skills of health workers and managers in both data quality, indicator analysis, and reporting as well as on basic computer hardware and application programs. These strategies are discussed as follows:

- **Participatory adaptation and implementation of DHIS:** This is a strategy that gives the opportunity for all stakeholders to collaborate and develop a feeling of ownership on the system to be introduced. The participation of all involved stakeholders in the process of software adaptation, standardization of existing data sets, indicators and reporting formats created an opportunity for inter-disciplinary learning and collaboration between IS people (including developers, implementers and facilitators) and health workers and managers. In this process, health workers and managers interact and negotiate on different public health related problems (such as the need for integration of reporting systems and standardization of essential data sets, the importance of indicators for action and decision making, the number, frequency and type of reports to be sent to higher levels and the feedback mechanisms to be established to communicate with lower levels) through formal workshops as well as small group discussions organized at different levels. For example, the two day workshop held in Assosa in June 2004, created an opportunity for several health workers and managers from different levels of the regional health bureau to interact, negotiate and learn on the problems of existing routine health management information system and formulate strategies and tools to curb existing problems and weaknesses of the system.

Besides, health workers and managers also participate on the customization of the software by giving comments on the layout of reports, the type of data missing, and the quality of reports generated. HISP implementers and facilitators, also got the opportunity to know about public health issues and problems including (indicators, reports, health services and programs) while they collaborated and interacted in standardizing existing data collection and reporting forms and adapting DHIS. The participatory adaptation and implementation strategy also creates opportunities to share the experiences and best practices of other HISP pilot regions. For example, Standardized data collection and reporting tools as well as DHIS software customized for Addis Ababa Health bureau were used as a point of departure to initiate the software customization and standardization process in Banishangu-Gumuz regional state.

- **Capacity building through training:** this is a strategy employed to upgrade the skills and competency of health workers and managers on wide diverse issues and topics including data management, indicator analysis, report generation, and the application of computers to undertake such tasks. In the context of this study, training aimed to improve the existing poor capacity of health workers and managers working on health data management and analysis were organized by HISP in collaboration with

the regional health bureau. For example, in 2004 a one week training on basic computer hardware, MS-Office application packages (including MS-Word, MS-Excel, MS-Access), and on the functionalities of DHIS software were offered to 22 health workers and managers represented from the regional health bureau, the three zones and some districts (woredas). Through capacity building initiative introduced to offer training on computer applications and data analysis and report generation using DHIS; it was possible to create basic awareness to health workers and managers on computer hardware and software, on health data collection, analysis and report generation using graphical tools such as Excel pivot table. To make the capacity building program more sustainable, the need for continuous training and support to people working on health data collection and analysis were underscored. However, in practice there was no any follow up training due to resource constraints (financial and material), infrastructural challenges and due to intense work load of health workers and managers at health facility and district levels.

4.2 Amhara Regional State

Amhara regional state is the second largest regional state (next to Oromia) with an area of 161, 828.4 km², located in northwestern part of the country. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA 2008), the region has a total population of 17.2 million with a mean annual growth rate of 1.7% of the total population. The population density varies from 5 persons per km² in low land areas of the northwest to 281 per km² in the highlands, with a mean density of 125 inhabitants per km² (WHO Consultancy Report 2004). The region is divided into 11 administrative zones, 118 districts (woredas) and 3,229 kebeles (the lowest administrative bounty) ((AHSDP III 2006).

The health care system in the region is largely underdeveloped and under resourced as a result of which the current system provides basic health services to only about 60% of the total population. Large proportion of the rural population has no access to basic health services. The region has 16 hospitals, out of which 3 are referral, 169 health centers and 2590 health posts (FMOH 2006).

4.2.1 Findings of the situational Analysis

Findings on Existing HIS

An assessment of the existing paper-based HIS conducted by the regional health bureau in collaboration with ESHE (Essential Services for Health in Ethiopia) project in 2004 showed that health data collection, reporting and analysis in the region is highly fragmented, top-down, inconsistent, and poor quality and redundant data being reported to higher levels. With regard to this, the head of the planning and programming department of the regional health bureau indicated that:

“ our assessment of reporting formats in health institutions, made it clear that our reporting system was fragmented and inconsistent between zones, districts and even health facilities”.

In the existing system, data flows upwards from health facilities and districts to the regional and national levels as well as to different vertical programs, but does not flow back down to health care providers and managers at health facility and district levels. The flow of routine reports in the region starts from health facilities where health workers collect the data on registers, fill it in reports and send to district (woreda) health offices. The district (woreda) health offices then compile summary reports (based on the reports of health facilities), and the aggregated report will be submitted to zonal health offices, which again compile the zonal report and sent to the planning and programming unit of the regional health bureau. However, besides the routine reports; health facilities, districts and zonal health offices are also required to compile independent reports to each vertical program.

Fragmentation of reports is another problem of existing HIS in the region. The system is expected to address the information needs of different health programs (such as Maternal and Child Health, HIV/AIDS, Malaria, tuberculosis etc) that are supported by different donor agencies as well the requirements of government organizations. To conform to the requirements of multiple programs and the regional health bureau, health workers at lower levels are forced to complete separate forms containing the same information to be delivered for different agencies who do not share data among themselves. As it is the case at national levels and in other regional states, vertical health programs significantly contribute to multiple reporting formats, fragmentation of reports, and an increased administrative workload on health workers and managers at health facility and district levels.

In summary, the empirical findings of this study showed that the routine paper-based HMIS in Amhara regional state had several problems including:

- Fragmentation of reports;
- Inconsistency and redundancy of reports;
- No feedback mechanism;
- Inadequate qualified manpower;
- Inappropriate use of available resources and digital infrastructure (including using computers assigned for HIS activities for only secretarial services).

Findings on existing infrastructure:

Although the region constitutes 15 % of the total geographic size of the country and 23.3 % of the total population (CSA 2008); the region is characterized by poor physical and digital infrastructure (including transport, electricity, telephone, internet and computer facilities), inadequate skilled manpower at all public health sectors including health and immense geographical distance between zones, districts and the regional capital (Bahir Dar). However, in recent days, due to the regional governments commitment to improve the physical and digital infrastructure in the region as an approach to improve public service delivery (including health and education); access to telephone, electricity and other digital technologies (such as computers and mobile phones) has improved remarkably.

In the health care sector, as per an assessment made by the researcher (see Shaw, Mengiste et al. 2007), 64 districts (out of the 118) in the region have access to latest computers (Pentium IV), all the 11 zonal health offices have computers in every unit including HMIS unit. Besides, as part of the effort of strengthening HIS capacity at district level, the regional health bureau had also distributed 70 new computers to districts of different zones in August 2007. The survey also revealed that almost all districts have access to telephone and electricity. However, though there is access to computers in all zonal health offices and in many district health offices; this study revealed that computers are not used for storing, analyzing and

reporting routine health data at zonal and district levels. At the regional level, there was an effort to use computers for data compilation and analysis by using some statistical data analysis tools such as Excel and Epi-Info. Another positive indicator in terms of access to digital infrastructure in the region is the world bank and IMF funded WoredaNet project which aims to enhance education, healthcare, and agricultural activities by connecting all districts, zones, and regional states through a broad band network which is expected to improve existing state of digital infrastructure at regional and national levels (ICTDA 2007).

Findings on Human resource related challenges:

Lack of adequate and trained human resource for health service delivery and management is one of the long-standing problems in the region that impedes the delivery of appropriate health services to the community (WHO 2004). This shortage of manpower both in number and quality needed is prevalent at all levels starting from the regional health bureau down through the health system up to the smallest health unit (health posts) (ibid). With regard to availability of adequate and skilled manpower devoted to HMIS activities, the empirical investigation conducted in the region revealed that there is acute shortage of qualified manpower to undertake HMIS related tasks at district, zonal and even regional levels. For example, at the regional level, the planning and programming unit is responsible for HMIS related activities, but it is under staffed and most of them lack proper training and skills on health data management and analysis. At zonal levels, there are only few zones that assign manpower to specifically deal with HMIS activities. At district level, there no such a position at all. Most of the respondents interviewed at regional and zonal health offices indicated that the existing poor state of qualified and adequate manpower to handle HMIS activities is exacerbated due to the following reasons:

- High profile requirements set by the regional health bureau (for example it demands at least diploma in health sciences and 5 years working experience);
- Low salary scale, poor remuneration and incentives;
- Lack of on the job training and skills upgrading schemes;
- Negative attitude by managers at all levels for HMIS related jobs (being considered as low standard job);
- Extreme workload in compiling and aggregating reports resulted to high attrition of staffs hired for the position.

4.2.2 Context-sensitive strategies

As it is the case in Benshangul-Gumuz, HISP in collaboration with the regional health bureau had also devised context sensitive strategies to deal with the challenges related to existing health management information system (HMIS), human resource and infrastructure. Drawing on the lessons and experiences of the regional health bureau to restructure existing HIS and the findings of the situational analysis conducted by HISP team members (including the author), the following sub-sections provide the approaches and strategies followed in dealing with the multi-faceted challenges of adapting and implementing computer-based HIS in different public health care institutions of the Amhara regional state.

Dealing with existing fragmented HIS:

The regional health bureau had recognized the weaknesses of the existing paper-based routine health management information system (HMIS) in terms of fragmentation of reports, duplication of efforts, unused data being collected, and lack of standardization across all levels. To deal with these challenges, the bureau in collaboration with some international organizations (such as ESHE) took an initiative to standardise existing data sets and data collection tools. Standardization of existing data sets, reporting formats and work practices

has been considered as a strategy to cope with fragmentation of existing HIS. To this end, in 2003 the regional health bureau established an ad-hoc committee to make an assessment of how the system works, and to identify the problems that affect the interoperability of the existing HIS at different levels. Regarding the work of the ad-hoc HMIS committee, the head of the planning and programming unit noted that:

“The HMIS committee and the experts (ad-hoc committee) discussed many and different sensitive issues of the formats and to do on assignment bases especially how to standardize and identify the bulky formats into monthly and quarterly ones. After this discussion each responsible body took the collected different reporting formats to comment on it. Each member of the group came with their very different idea and a very thorough and detail discussion has been done. All the suggestions could be included in the format (done by the planning and programming service of the Regional Health bureau) and another discussion has been made, of course many times”

In 2004, HISP initiated its activities in the region and reached agreement with the regional health bureau to collaborate in finalizing the standardization process, customize DHIS software and implement the system to different public health institutions of the region. HISP's initiative to support on data standardization as well as customize and introduce the district-based health information software (DHIS) was accepted with strong support and commitment by the regional health bureau officials and the planning and programming unit. HISP-team members then joined the ad-hoc team at the beginning of 2005 and collaborate on the standardization process while at the same time undertaking the customization of the software. An initial draft of the essential data sets and reporting formats as well as regional indicators was developed by the ad-hoc committee and presented to different stakeholders in a workshop held in September 2005. The final report of the standardized regional data sets and reporting formats was released in December 2005. One of the essential contributions made by HISP in the standardisation process was the introduction of the hierarchy of standards approach in developing essential data sets for different levels. The hierarchy of standards approach gives flexibility for health workers and managers at lower levels (health facilities and districts) to include data sets they need at a local level as they long as they send reports as per the requirements of the higher levels.

The HISP team members used the new standardised format to customize DHIS ver. 1.4 before the system was implemented at regional and zonal levels. However, implementing the system to lower levels was a challenging task for HISP-Ethiopia team members as well as to the regional officials. More specifically, the lack of trained and qualified manpower (with skills and knowledge on computer applications) to handle the system at lower levels had been a threat to sustain the system at lower levels. Besides, due to differences in access to digital and physical infrastructure across districts in different zones, HISP was forced to develop context-sensitive implementation approaches and strategies. The following sub-sections, therefore, provide an overview of how the different challenges were dealt in the region.

Dealing with human resource challenges:

As it reported by Shaw, Mengiste et al. (2007), HISP tackled the challenges of inadequate and trained human resource at all levels of public health care system in the region by introducing a capacity building program in collaboration with the regional health bureau. For example, when a decision was made to implement the system to all zonal health offices, a two weeks training program was organized in May 2006 for trainees from each respective zonal health office. The training focused on two main issues: 1) basic skills on computer hardware, operating systems and application programs (such as MS-Word and MS-Excel); and 2) on functionalities of DHIS 1.4 and principles of data capture, analysis and report generation using the software.

However, short after the training, most of the trainees encountered problems to install and use the system once they were back to their zones which demanded a group of HISP team members (including the author) to travel to all zonal health offices in July 2006 and provide on-site training and support for a group of people including managers, HIS officers and statisticians. In our visit to zonal health offices, we found out that none of the trainees had managed to successfully install the software let alone start to use it. This was partly due to the trainees' lack of background knowledge and skills on computing technologies. As one HIS focal person who participated during the first round training noted that:

“... the training given for us in May 2006 in Bahir Dar was good, but for most of us with less background and knowledge even on basic computer applications, the complex instructions and dialogue boxes popping up during installation of DHIS software makes it very difficult to install the system.”

Dealing with Infrastructure related challenges:

Compared to the situation in Benishangul-Gumuz, Amhara regional state is in a better position with regard to access to computers, electricity, and communication and transportation facilities especially at zonal and regional levels. At district levels, there is uneven development where we find some districts with full-fledged access to the specified infrastructural facilities, while others remote and inaccessible even with road transportation. Taking this uneven distribution, HISP has devised a strategy that allows uneven development in terms of implementing the computerised system by implementing the system in those districts which have access to computers, communication, electricity and transportation facilities. For those districts without access to basic infrastructural facilities, HISP adopted a gateway strategy that allows integrating paper-based systems with computerised systems at different levels. For example, all health facilities will use the standardized paper-based reporting formats to send monthly or quarterly reports to districts. Those districts without access to computers will also use standardized forms to compile the report from each health facility in that district and sent to their respective zonal health offices. It is at the zonal level that every data coming from all districts will be stored into computers and reports will be sent to the region electronically.

4.3 Outcomes of the context-sensitive strategies

I personally believe that strategies should not be evaluated in terms of their results or outcomes, but in terms of their strength in linking with the specific context. As such, the context-sensitive strategies adopted and employed in both Amhara and Benishangul-Gumuz helped to identify specific contextual challenges contributed in building local capacity, standardizing data sets and data collection formats, establish strong partnership with regional health bureau officials as well as managers of vertical programs. For example, in Benishangul-Gumuz region, in spite of the adverse situation in the region (in terms of infrastructure, manpower, and fragmentation of existing HIS), at the initial stages of the project, the HISP team members in collaboration with the management of the regional health bureau managed to identify constraints and put forward strategies to standardise existing fragmented and inconsistent data elements and reporting formats, build the capacity of health workers and managers at different level through trainings, workshops, mutual engagement and learning programs. In short period (from July to December 2004) the software was customized implemented at the regional health bureau and one zonal health office. However, when time goes, it was not possible to keep the momentum and reinforce the implementation process due

to several factors (some of which are presented in the following section). In Amhara, up until all the HISP initiatives were discontinued due to the decision of the Federal Ministry of Health by giving the mandate of HIMS reform activities both at regional and national level to an international consultancy firm; several context-sensitive strategies were formulated and the software customization and implementation process was undertaken based on those strategies. As a result, HISP in collaboration with the management of the regional health bureau managed to develop standardized regional data sets and reporting formats, introduced capacity building initiatives (including trainings, workshops, participatory learning, on-site support), and implemented DHIS 1.4 at the regional health bureau and all the 11 zonal health offices in the period from 2005 to 2007. The strategy of reaching out to districts with access to computers was not materialized due to the decision of the Federal Ministry of Health. In sum, the major impediments that influenced the process of customizing and implementing the computer-based health information system in the two regional states were:

- The implementation was structured to be undertaken by MSC and PhD students (including myself) as part of their research project, and when they are away from the field to pursue their academic work; all the task of software customization, user training and coordinating the implementation process in each respective region stacks even though regional facilitators were hired to maintain the momentum. The facilitators often do the technical support in those sites where the system is implemented and left aside the important task of negotiating with regional health bureau officials for additional resources and reaching out new health facilities, or districts. This lack of progress in reaching out new zones and districts (more specifically in Benishangul-Gumuz) makes the regional health bureau officials unhappy and significantly influenced their motivation and interest to collaborate with HISP.
- The frequent staff turnover (mainly medical doctors and management team members) seeking for better salaries and benefits at international organizations contributed for losing of key HISP allies who have been leading HMIS reform initiatives in the region. A case in point is the departure of two of our champions in Benishangul-Gumuz regional state to join international non-governmental organizations (NGOs) in Addis Ababa. Their departure was a blow for HISP and partly explains the limited success of HISP in terms of stimulating the change process at district and even zonal levels.
- The decision of the Federal Ministry of Health (FMoH) to disband HISP's operation both at national level and in the pilot regions where HISP was operating.

5. Analysis and Discussion: the need for flexible strategies

The process of developing and implementing IS in the context of developing countries is a challenging task (Heeks 2002; Avgerou 2002, 2007). This challenge mainly emanates from existing adverse situation of the installed base that is characterised by uneven infrastructural development across regions, inadequate skilled manpower, lack of integration and fragmentation of existing standards, tools, and work practices, and varying political commitment and organizational support at national, regional and district levels. The installed base and the impediments associated with it demand different strategies to be adopted and implemented for different contexts and settings. The strategies and approaches adopted are

also influenced by a wide variety of factors including: maturity of the new system to be implemented in the new setting, availability of required skills and knowledge to handle the system, project size and complexity, availability of resources and the required infrastructure, and unanticipated events that occur after the initiation of the project.

As it presented in the empirical findings of this paper, the process of introducing computerised HIS in two regional states of Ethiopia has been fraught with challenges and tensions emanating from fragmented structure of existing programs and services as well as infrastructural and human resource constraints. The empirical findings also provide an account of the different approaches and strategies employed to deal with the challenges encountered in different contexts and settings. Different strategies were formulated based on an assessment of the contextual aspects in terms of access to digital and physical infrastructure, availability of adequate and skilled manpower, and managerial commitment and support to introduce change to existing systems, standards and work practices.

One important implication of the empirical findings is the importance of the cultivation approach to deal with the complex socio-technical challenges of IS development and implementation in the context of developing countries. The cultivation approach allows change to occur in an incremental and step-by-step fashion over an extended period of time with minimal disruption to existing systems, technologies, standards and work practices (i.e. the installed bases). Organizations that adopt the cultivation strategy would nurture continuity and grow in a step-by-step fashion by enhancing and improving existing infrastructure, adapting and customizing technologies, strengthening local competency and capacity, and incrementally changing routines and work practices. Although the cultivation approach is useful to deal with specific problems (including infrastructural, human resource and fragmented HIS) in a particular setting; it is difficult to employ it in contexts that require radical changes or in settings that need to accommodate differences and diversity. The cultivation approach is often criticized for its lack of flexibility to respond to radical changes in the external environment (Salmela & Spil 2002). This paper, therefore, argues that, though the cultivation approach is useful to introduce change incrementally, it can be complemented by formulating flexible strategies to address context-sensitive challenges in the process of introducing computer-based systems and tools in developing countries.

The need for Flexible strategies:

To ensure success in IS development and implementation, the need to account for various contextual factors and issues has been emphasised by several researchers and practitioners (see for example Brown & Vessey 2003; Grossan & Walsh 2006; Robey et al. 2002). Different strategies have been proposed ranging from the complete implementation of the system within a short period of time (the “big bang”) to incremental implementation based on a phased approach over a certain period of time (see Brown & Vessey 2003). Heeks (2002) also noted that lack of appropriate strategies are the main cause of failures in IS projects in many developing countries. However, as Gebauer & Lee (2007) noted identifying IS implementation strategies is a challenging task mainly due to uncertainties and trade-off effects that need to be taken into account.

This paper argued on the importance of developing context-sensitive strategies by taking into account diversity and contextual differences in the process of implementing computer-based HIS in different settings of developing countries. Due to uncertain and unpredictable nature of the public health arena and the uneven infrastructural development, poor human resource capacity, and fragmentation of existing systems; it seems to be little value to come up with

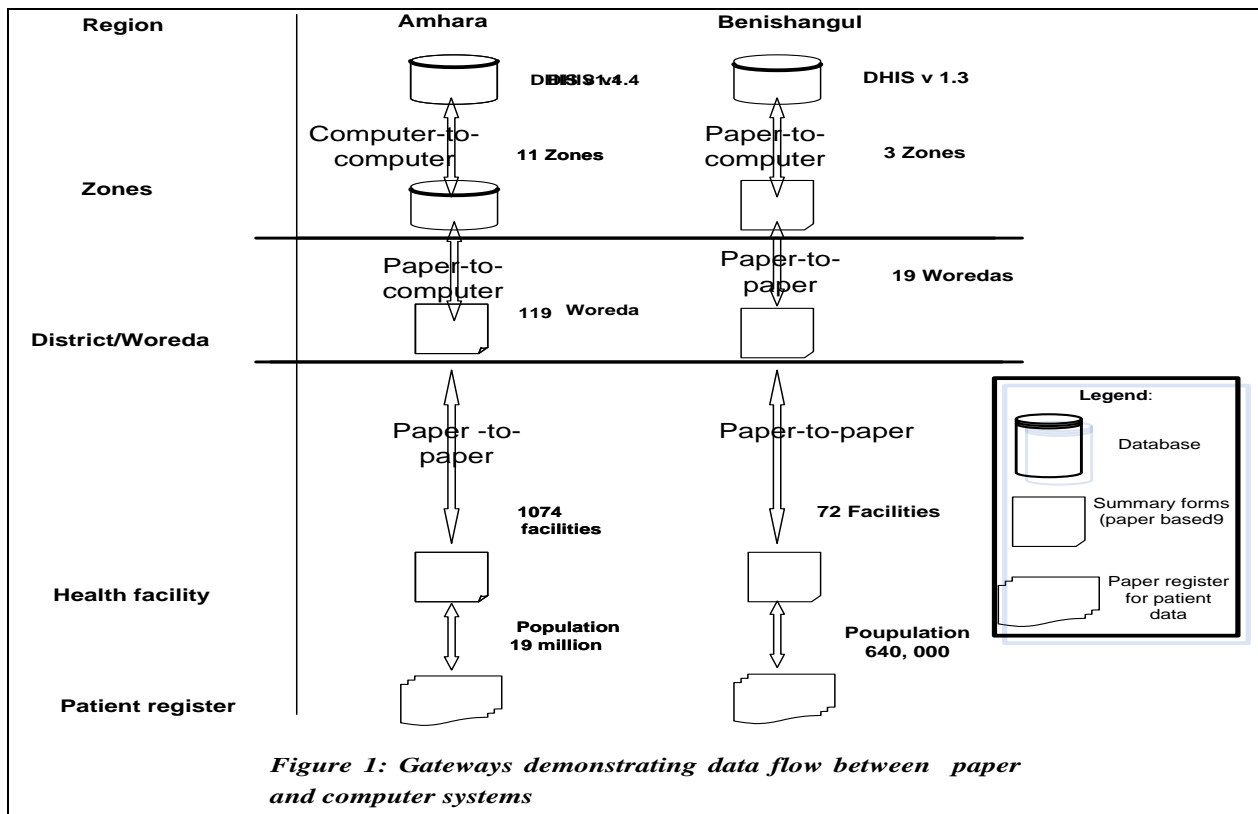
comprehensive strategies that could be used as universal solutions in all settings and contexts. In line with this, Bhandari et al. (2004) noted that because of the complexities and variations in context, it is not possible to develop generic strategies and deploy them in different contexts and settings. Strategies, should rather be emergent and targeted in tackling impediments posed by contextual factors.

As such, this paper goes one step further and argues the importance of adapting ‘flexible strategies’ to deal with context-sensitive challenges of adapting and implementing computerized IS in the context of developing countries. The uncertain and unpredictable situation encountered in different settings needs to be tackled through flexible strategies that are tailored to comply with specific challenges and opportunities at that specific time and place. As opposed to the cultivation approach which focuses on continuity and gradual change, the flexible approach focuses on the ability to adapt, in a reversible manner, to an existing situation (Bucki & Pesqueux 2000 pp. 2). In the context of this study, four flexible strategies are identified as being essential in the process of adapting and implementing computer-based HIS in two regional states of Ethiopia. The following sub-sections presents gateways, flexible essential data sets and clustering as flexible strategies adopted in this study.

Gateways:

One example of a context-sensitive strategy adopted implementing DHIS was the use of gateways. The gateway approach had been used to deal with lack of access to computers at zonal and district levels. As Hanseth (2002) indicated, gateways play important roles in different situations at different phases of information infrastructure development. For example, they can be used to connect heterogeneous networks, being built independently or based on different versions of the same standards (ibid).

Similarly, the findings of this paper provide empirical examples on how gateways have been used to create an interface between paper-based and computerised systems in both Amhara and Benishangul-Gumuz regional states. When there is uneven development in terms of access to digital and physical infrastructure across regions and districts as it is the case in this study, gateways provide flexibility to address constraints by allowing data flow and communication through paper-to-paper, paper-to-computer and computer-to-computer interfaces. For example, if we compare the actions and strategies adopted in changing existing paper-based routine reporting system with an integrated computerised HIS both in Amhara and Benishangul-Gumuz regional states; in Amhara, due to a relatively better access to digital infrastructure, it was possible to establish paper-to-computer gateways for data compilation and transmission at zonal level and even at district levels in some cases. Where as in Benishangul-Gumuz, due to poor access to computers and other infrastructural resources both at district and zonal levels, paper-to-paper gateways have been used for data capture, compilation and analysis all the way to the regional level. Braa et al. (2007a) emphasized on the need for flexibility of standards (such as essential data sets and reporting formats, technical artifacts such as DHIS) to cultivate existing installed bases and accommodate changing requirements over time. As such gateways serve as interfaces between different standards. Gateways, therefore, provide “an interface to link and translate between paper-based and electronic infrastructures, or between incompatible electronic infrastructures” (ibid pp.17). The gateway approach, as such contributed in managing data integration at different levels.



Top-down vs. bottom-up implementation:

Although the philosophy of the global HISP program is on bottom-up development, customization and implementation of DHIS software (often at district level), in the case of this study we were forced to adapt top-down strategy to deal with the problem of access to computers, electricity and other infrastructural resources at zonal (Benishangul-Gumuz) and district levels (Amhara). In practice the HISP team members both in Benishangul and Amhara decided to combine both the top-down and bottom-up approaches. That means when there is access to infrastructural resources as well as qualified manpower at lower levels, the bottom-up approach will be adopted, but if not the top down strategy will be used. This allowed uneven development to occur between districts and zones. For example, due to differences in geographic size and existing infrastructure between Amhara regional state (which has vast geographical size with 11 zones and 119 districts (woredas), relatively better infrastructural access at zonal level and in some districts) and Benishangul-Gumuz (which has smaller geographic size only 3 zones and 19 districts (woredas); poor access to infrastructure both at zonal and district levels); different approaches were followed in adapting and implementing DHIS as well as new standards and tools in the two regional states. As such, in Amhara, for example, efforts to implement DHIS 1.4 (see Shaw, Mengiste and Braa 2007) required to mix both the top-down and bottom-up approaches where the system was implemented to all the 11 zones initially and to scale down to the lower administrative levels later on (to districts) by taking into account availability of technical infrastructure (computers, electricity, telephone). In Benishangul-Gumuz, however, due to lack of infrastructural resources at two out of three zones the strategy was only to follow the top-down approach and to focus on improving access to infrastructure at lower levels.

Flexible standards:

The principle of flexible standards (Braa et al 2007a) allows local flexibility in adding data elements required at lower levels (health facility and district), but by conforming to central requirements at the same time. In the flexible standards approach, rather than using one universal standard that covers everything; hierarchy of standards are created (see figure 2 below). One example of flexible standards is the development of flexible “essential data sets” (EDS) by introducing the principle of hierarchy of standards (see Braa & Hedberg 2002; Braa et al 2007a). This approach enables local users to expand the essential data sets to address their specific needs, while still reporting on the essential data required at the central level (Shaw, Mengiste et al. 2007). The strategy of flexible essential data sets have been adopted both in Amhara and Benishagul-Gumuz while standardizing the regional data sets and implementing them. By standardising existing fragmented reporting formats and reducing the number of data elements and reporting formats at all levels, this strategy aimed to reduce the work load of health workers at lower levels, improve the flow of good quality data, and allow the local health workers and managers to include the data elements they need at a local level as long as they conform to the requirements of the higher level. This approach, with or without the application of computers can contribute for good quality data to be reported to higher levels. For example in Amhara, though DHIS was implemented at the regional and zonal levels, the standardized system and reporting formats were implemented to health facility and district levels allowing an integrated data flow at all levels.

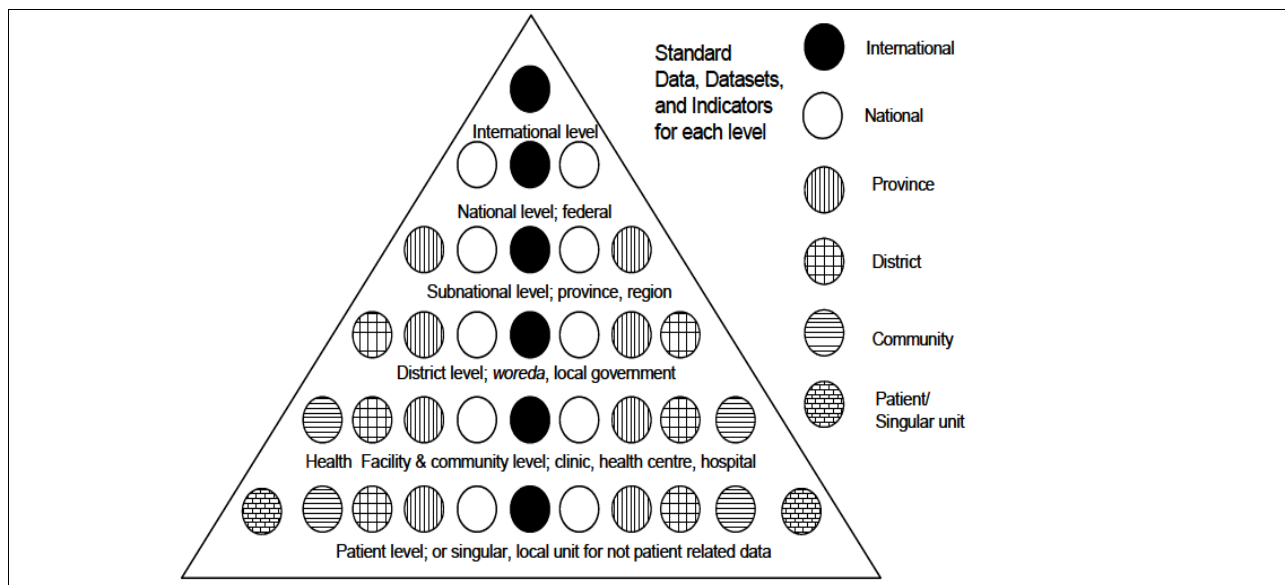


Figure 1: Flexibility through Essential data sets (as presented by Braa et al. 2007a).

Clustering:

This strategy had been adopted in Benishangul-Gumuz regional state mainly due to inadequate capacity and poor infrastructural situation to deploy computers at district and health facility levels. This strategy allows gradual expansion whereby priority was given in identifying alternative approaches to deal with the adverse state of infrastructural problems at zonal and district levels and in mitigating human resource challenges through on-going capacity building programs. With regard to the infrastructural challenges (mainly related to access to computers at zonal and district levels), an effort was exerted to alleviate the problem both by convincing officials of the regional health bureau to purchase and distribute computers to lower levels and

by reaching out non-governmental organizations (NGOs) working in the region to donate used computers. In the clustering approach, computers and generators will be deployed centrally in a health facility and serves as a hub to a group of health facilities that have geographical proximity. Then all the health facilities will send their paper-reports to the central location whereby data capture, compilation will be made centrally for all health facilities in that hub and reports will be sent to the higher level electronically from the central hub. The same structure can be made fro different districts that have geographic proximity. This arrangement allows optimal utilization of resources and technical support can easily be delivered to the central hubs. In this study, the clustering approach was tested in one district (Menge Woreda) in Benishangul-Gumuz and an encouraging result was achieved. A similar approach had been reported by Sahay and Walsham (2006) in the process of scaling computerised HIS in India.

6. Concluding Remarks

In this paper, we investigated the diverse socio-technical challenges of adapting and implementing computerised HIS in public health settings of Ethiopia. By comparing the infrastructural, human resource and structure and functioning of health management information systems in two regional states; the paper analysed the challenges and approaches of introducing computer-based information systems in resource constrained settings. The dilemma faced by those who are engaged in reforming health management information systems in the context of developing countries is the uncertain and unpredictable environment of public health care system of developing countries as well as uneven infrastructural development, fragmented nature of HIS and poor human resource competency across different levels. The public health arena is uncertain and unpredictable because of new policies, strategies, and regulations both on public health care and HIS activities that are triggered by the requirements of international agencies (such as WHIO-HMN 2008 for example), national governments, NGOs supporting vertical programs, and regional and district governments. The importance of the attitudes and preparedness of policy-makers and managers towards the change process cannot also be underestimated. One important lesson that come out of this study is that, lack of resources (infrastructural, financial and skilled manpower), as well as uncertain and unpredictable environments constrain the process of introducing ICT based systems and tools in the context of developing countries. In such settings, it is problematic to formulate comprehensive strategies that would address different challenges and problems in different contexts. As such, this paper suggested the importance of adapting flexible strategies to deal with context-sensitive challenges.

The empirical analysis of this study showed how it is difficult to employ strategies developed in one setting to address challenges encountered in another setting before they are appropriated and adapted to fit to the new context. Lessons learned and strategies developed in one setting could only be used as points of departure to develop new strategies by taking into account infrastructural, human resource, existing systems, and work practices and tools in the new setting. Strategies developed for one setting can't also be used for good to deal with all the problems in that setting. They should rather be regularly negotiated and reformulated based on emergent trends and problems, new interests, new policies, new actors, and uncertainties from the external environment. Such strategies should only be developed and maintained through continuous learning, negotiation, and by being sensitive to changes and uncertainties in the environment. That is why, this paper emphasized the importance of developing flexible strategies to deal with context-sensitive challenges in the process of implementing computer-based IS in developing countries which are often characterized by uneven development across regions in the same country and between zones and districts within the same region.

References

- Aanestad, M. (2002). Cultivating Networks: Implementing Surgical Telemedicine. Faculty of Mathematics and Natural Sciences, Oslo, University of Oslo, Norway. PhD Thesis.
- Abouzahr, C. & Boerma, T. (2005). Health information systems: the foundations of public health. *Bulletin of the World Health Organization* 83(8): 578-583.
- Alvarez, A. J. S. (2004). Challenges of information systems implementation in organizational change management: insights from the health sector in Ecuador. *Electronic Journal on Information Systems in developing Countries*, 16(6): 1-16.
- Amhara Health Sector Development Program (AHSDP). (2006). Amhara Regional health Bureau. Unpublished material, Baher Dar, Ethiopia.
- Avgerou, C. (2002). Information Systems and Global Diversity. Oxford, United Kingdom: Oxford University Press.
- Avgerou, C. & Walsham, G. (2001). Information Technology in Context: Studies from the perspective of Developing Countries. Hampshire, United Kingdom: Ashgate.
- Avgerou, C. (2007). Information systems in developing countries: a critical research review. Working Paper Series, London School of Economics and Political Science.
- Berg, M. (2001). Implementing Information Systems in Health Care Organizations: Myths and Challenges. *International Journal of Medical Informatics* 64: 143-156.
- Bhandari, G. et al. (2004). Flexibility in e-Business strategies: A requirement for success. *Global Journal of Flexible Systems Management*, 5(2&3): 1-22.
- Bhatnagar, S. C. and Bjørn-Anderson, N. (eds.) (1990). Information Technology in Developing Countries. Proceedings of the IFIP TC/TC (Working Conference on the Impact of Information systems on developing Countries. New Delhi, India, 24-26 November, 1988.
- Bishaw, S. B. (2008). Institutional strategies towards improving health information systems (HIS) in Sub-Saharan Africa. In IFIP International Federation for Information processing, Volume 282; Social Dimensions of Information and Communication Technology Policy; Christian Avgerou, Mathew L. Smith, Peter Van den Besselaar; Boston: Springer, pp. 191-207.
- Braa, J. and Hedberg, C. (2002). The struggle for district-based health information systems in South Africa. *The Information Society* 18(2), 113-127.
- Braa, J., Macome, E., Da Costa, J.L., Mavimbe, J.C., Nhampossa, J.L., Jose, B., Manave, A., and Sitoi, A. (2001). A Study of Actual and Potential Usage of Information and Communication Technologies at District and Provincial Levels in Mozambique with a focus on the health sector. *Electronic Journal on Information System in Developing Countries* 5(2): 1-29.
- Braa, J., Monteiro, E. Sahay, S.. (2004). Networks of Action: Sustainable Health Information systems Across Developing Countries. *MIS Quarterly* 28(3): 337-362.
- Braa, J., O. Hanseth, Heywood, A., Mohammed, W., Shaw, V. (2007a). Developing health information systems in developing countries: the flexible standards. *MIS Quarterly, Special Issue on IT and development*, 31: 381-402.
- Braa, J.; Monteiro, E.; Sahay, S.; Staring, K.; & Titlestad, O. H. (2007b). Scaling up local learning-experiences from South-South_North Networks of shared software development. Proceeding of IFIP 9.4, Sao Paulo, Brazil.
- Brown, C. V. & Vessy, I. (2003). Managing the next wave of enterprise systems: Leveraging lessons from ERP. *MIS Quarterly Executive*, 2(1): 65-77.
- Bucki, J & Posqueux, Y. (2000). Flexible workshop: about the concept of flexibility. *International Journal of Agile Management Systems*, 2(1): 62-70.

- Central Statistical Authority-Ethiopia. (2008). Summary and statistical report of the 2007 population and housing census. Addis Ababa, Ethiopia.
- Chilundo, B. & Aanestad, M. (2004). Negotiating multiple rationalities in the process of integrating the information system of disease specific health programmes. *Electronic Journal on Information Systems in developing Countries*. 20(2): 1-28.
- Cibbora, C., Braa, K., Cordella, A., Dahlbom, B., Failla, A., Hanseth, O., Hepsø, V., Ljungberg, J., Monteiro, E., Simon, K. A. (2000). From Control to Drift. The Dynamics of Corporate Information Infrastructure. Oxford, UK, Oxford University press.
- Dahlbom, B. and Janlert, L. E. (1997). Computer Future. Unpublished manuscript, Department of Computer Science, Umeå University, Umea.
- Federal Ministry of Health (FMoH). (2006). Health and health related indicator. Planning and Programming Department, Addis Ababa, Ethiopia.
- Flatie, T. ; Gedif, T.; Asres, K. & Gebre-Mariam, T. (2009). Ethnomedical survey of Berta ethnic group Assosa Zone, Benishangul-Gumuz regional state, mid-west Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, 5(14): 1-11.
- Gebauer, J. & Lee, F. (2007). Enterprise systems flexibility and implementation strategies_aligning theory with evidence from a case study. Available at URL: www.business.illinois.edu/Working_Papers/papers/07-0113.pdf
- Grossan, T. & Walsh, J. (2004). Avoiding the pitfalls of ERP system implementation: *Information Systems Management*, (spring), 38-42
- Hanseth, O. (2002). From Systems and Tools to Networks and Infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology implications. Available at URL: http://heim.ifi.uio.no/~oleha/Publications/ib_ISR_3rd_resubm2.html
- Hanseth, O. & Aanestad, M. (2003). Bootstrapping networks, communities and infrastructures: On the evolution of ICT solutions in healthcare: *Methods of Information in Medicine*, 42, 385-391.
- Hanseth, O. and Lyytinen, K. (2004). Theorizing about the design of Information Infrastructure: design Kernel theories and principles, Unpublished work.
- Hanseth, O. and E. Monteiro (1997). Understanding information infrastructure, Unpublished manuscript. Available at URL: <http://heim.ifi.uio.no/~oleha/Publications/bok.pdf>.
- Hanseth, O. and Monteiro, E. (1998). Changing Irreversible Networks: Institutionalization and Infrastructure. Proceedings of the 20th edition of IRIS.
- Hanseth, O., Cibbora, C. U., Braa, K. (2001). The Control Devolution: ERP and the side effects of Globalization. *The Data Base for Advances in Information systems, Special Issue on ERP Systems* 32(4): 34-46.
- Hanseth, O., Monteiro, E. and Hatling, M. (1996). Developing Information Infrastructure: The Tension between Standardization and Flexibility. *Science, Technology and Human Values* 21(4): 407-426.
- Health Sector Development program (HISDP III)- Federal Ministry of Health-Ethiopia. (2005). Health Sector Strategic Plan 2005/6-2009/10. Planning and Programming Department, Federal Ministry of Health, Addis Ababa, Ethiopia.
- Heeks, R. (2002). Information Systems and developing Countries: Failure, Success, and local improvisation. *The Information society*, 18: 101-102.
- Heeks, R. (2002). Failure, Success and improvisation of information systems projects in developing countries. *The Information Society*, 18: 101-112.
- Igira, F. T. (2008). The interplay between transformation in everyday work practices and IS design and implementation processes: Empirical experiences from the health

- Information Systems in Tanzania. Faculty of Mathematics and Natural sciences, University of Oslo. **PhD Thesis.**
- Information and Communication Technology Development Agency (ICTDA)- Ethiopia. (2007). ICT Assisted Development project: Monitoring and evaluation report on information need of farmers and pastoralists, Addis Ababa, Ethiopia. Available at URL: <http://www.ictadethiopia.org/documents/202da165a25345d90045cfa7d290f716359c8c06.pdf>.
- Jacucci, E., Nilsen, P., Berge, I. (2002). Bootstrapping the Electronic Patient Record Infrastructure. Proceedings of the IRIS 25th Edition of IRIS, Denmark.
- Kimaro, H. C. (2006). Decentralization and sustainability of ICT based health information systems in developing countries: A case study from Tanzania. Faculty of Mathematics and Natural Sciences, University of Oslo. **PhD Thesis.**
- Kimaro, H. C. & Nhampossa, J. L. (2005). Analysing the problem of unsustainable health information systems in less-developed economies: case studies from tanzania and Mozambique. *Information Technology for Development*, 22(3): 273-298.
- Lungo, J. H. (2008). Design-reality gaps in open source information systems development: An action research study of education and health care systems in Tanzania. Faculty of Mathematics and Natural sciences, University of Oslo. **PhD Thesis.**
- Mackenzie, D. (1999). Technological determinism. In: W. H. Dutton (Ed.), *Society on the Line: Information Politics in the Digital Era*, Oxford University Press, Oxford, pp. 39-41.
- Melkamu, B. (2004). Fiscal Decentralization in Benishangul Gumuz Region: A review of problems of fiscal imbalance. Addis Ababa University, Addis Ababa, Ethiopia. **MSc Thesis.**
- Mengiste, Shegaw A. (2005). Challenges and opportunities of Implementing District-based Health Information System in Ethiopia: A Case Study from Benishangul-Gumuz Region. In Bada, A. & Adalakun, O. (eds.). Proceedings of the IFIP W.G 9.4-Working conference on enhancing human resource development through ICT. Abuja, Nigeria. pp. 256-267.
- Mosse, E. (2005). Understanding the introduction of computer-based health information systems in developing countries: Counter networks, communication practices and social identity. Faculty of Mathematics and Natural sciences, University of Oslo. **PhD Thesis.**
- Mosse, E. and S. Sahay (2003) Counter Networks, Communication and Health Information Systems: A Case Study from Mozambique. In *The IFIP TC8 & TC9/WG8.2+9.4 Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization*. M. Korpela, R. Montealegre and A. Poulymenakou (Eds), Athens, Greece: 35-51.
- Nhampossa, J. L. (2006). Re-Thinking Technology Transfer as Technology Translation: A Case Study of health Information systems in Mozambique. Faculty of Mathematics and Natural sciences. Oslo, University of Oslo. **PhD Thesis.**
- Nilson, A., Griost, M. and Aanestad, M. (2002). Electronic Patient Records- and Information Infrastructure for Health Care, Proceedings of the 25th Edition of IRIS, Denmark.
- Orlikowski, W., J. (1996). Improvising Organizational Transformation over Time: A Situated Change Perspective. *Information Systems Research* 7(1): 63-92.
- Robey, D., Ross, J. W. & Boudreau, M. C. (2002). Learning to implement enterprise systems: an exploratory study of the dialectics of change. *Journal of Management Information Systems*, 19(1): 17-46.
- Sæbø, J. and Titlestad, O. (2003). Evaluation of a Bottom-up Action Research Approach in a Centralised Setting: HISP in Cuba. University of Oslo, Faculty of Mathematics and Natural sciences, **MSc Thesis.**

- Sahay, S. and Walsham, G. (2006). Scaling of Health Information Systems in India: Challenges and approaches. *Information Technology for Development* 12(3): 185-200.
- Salmela, H. & Spil, T. A. M. (2002). Dynamic and emergent information systems strategy formulation and implementation. *International Journal of Information Management*, 22: 441-460.
- Shaw, V., Mengiste, Shegaw and Braa, J. (2007). Scaling of Health Information Systems in Nigeria and Ethiopia- Considering the Options. IFIP WG 9.4, São Paulo, Brazil.
- Söderström, M. and Nordström, T. (2005). A Careful Cultivation of the IS Change Process. Available at URL: <http://www.informatik.umu.se/gru/kurssidor/2005/vt/infa32/mom1/nat/Pdf/ECIS99.pdf>.
- United Nations Development Programme (UNDP). (2002). Joint Situation Assessment Mission to Benishangul- Gumuz Region, Addis Ababa , Ethiopia.
- Vital Wave Consulting. (2009). Health Information Systems in Developing Countries: A landscape analysis.
- Walsham, G. (1993). *Interpreting Information Systems in Organizations*. New York, USA, John Wiley and Sons.
- World Health Organization- Health Metrics network (WHO-HMN). (2007). Assessment of the Ethiopian Health Information System: Final Report. Available at URL: http://www.who.int/healthmetrics/library/countries/hmn_eth_his_2007_en.pdf
- World Health Organization (WHO)-Country representative. (2004). Consultancy report: emergency situation in Amhara region. Bahir-Dar, Ethiopia.

APPNDIX V

Mengiste, Shegaw A. & Aanestad, M. (2009). Understanding the Dynamics of Learning Across Social Worlds: A Case Study from introducing IS into the Ethiopian public health care system. *Information and Organization* (Revised and re-submitted).

Understanding the Dynamics of Learning Across Social Worlds: A Case Study from introducing IS into the Ethiopian public health care system.

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Information & Organization Journal (Revised Version)

Abstract

This paper advocates a learning perspective on information systems development, and we draw on IS research that conceptualizes development and implementation of information systems as a learning process. Building on the works of Anselm Strauss we conceptualize organizations as “social worlds” rather than viewing them as systems (as in the cognitively oriented learning research) or as communities of practice (as in the practice-based view). Using this perspective offers us an opportunity to understand the dynamics of learning which stems from differences and tensions between various actors belonging to different organizational contexts. Drawing on empirical material from the Health Information Systems Program (HISP) initiative, which is focussed on development, customization and implementation of a computerised health information system in Ethiopia, the paper analyses the dynamics of learning. We describe and analyse the interaction between IS developers and public health care domain experts, the evolution of technological capacity, and the organizational commitment and buy-in in the process of developing, customizing, and implementing the two different versions of DHIS software. We end by discussing the benefits of the social worlds perspective, and sketching practical and theoretical implications for the IS field.

Key words: IS development, Learning, social worlds, Public health system, developing countries

Introduction

In this paper, we show how the development and implementation of health information systems can become an arena for mutual learning and interaction among different social worlds, both from the public health and the information systems (IS) domains. Based on a case study where open source software (the District-based Health Information System - DHIS) was developed and implemented in the Ethiopian public health care system, we analyse how learning occurred in processes of encounters and negotiations between members from different social worlds and sub-worlds.

The emphasis on the role of learning in the IS field is not new. The development, implementation and adaptation of information systems in different organizational contexts has been analyzed as a learning, communication, and negotiation process by several IS researchers (see Lyytinen 1987; Curtis, Krasner & Iscoe 1988; Newman & Nobel 1990;

Zhong & Majchrzak 2004; He 2004). On the one hand, information systems are designed and employed to enable more effective operational practices (Wastell 1999) – a process that is supposed to lead to organizational learning. On the other hand, the work of IS development, adaptation and implementation in itself inevitably requires team members to work together to discuss, negotiate, and interact on what they are building and on how they coordinate their activities. This focus has been emphasised by several IS studies that have pointed out how systems development is a process of mutual and interactive learning where systems developers learn about the non-technical context and would-be users learn about the features and functionalities of the hardware and software (Boehm 1991; Braa, Monteiro, & Reinert 1995; Aarts, Peel & Wright 1998; Addison and Vallabh 2002; Bondarouk 2006). IS researchers have emphasised the need to create a user-developer environment and ensure knowledge sharing and communication about the application domain and the technology to be implemented (e.g. Bratteteig, 1997, Scott and Vessy 2000; Mathiassen & Pedersen 2005). New knowledge, skills, and new collaborative routines need to be simultaneously developed. In Boland's (1978) terms, this is a mutual learning process where both domain experts (users) and technologists (developers) recognize each others' distinctive capabilities and views. As Wastell (1999) specified, both IS professionals and users must engage in an intensive learning experience, the former to develop a thorough understanding of the business domain, the latter to reflect on current work practices and to develop an understanding of the potentials of technology to transform how work is done. Although other factors (such as organizational politics, management support, availability of resources etc.) also influence the outcome; an effective learning process within and between different social worlds is critical to the success or failure of an IS development and implementation project (ibid).

However, while the need for learning during various phases of the IS development and implementation process is generally recognized, the IS literature on this topic appears diverse and fragmented. As Huysman (2000) noted, "most literature tends to lean unnecessarily in certain directions, while overlooking others" (ibid pp. 81). For example, some studies attempt to adopt the learning perspective in IS design and development without taking into account the complex dynamics of learning between different stakeholders, the different learning mechanisms, the learning outcomes and the obstacles encountered in the process. With regard to the units of analysis (levels of learning), the literature is fragmented in terms of whether the individual, group or organization learns (see for example Curtis, Krasner & Iscoe 1988; Huysman 2000; Robey, Bourdeau & Rose 2000; Majchrzak & Beath 2000). Regarding the learning mechanisms, some IS scholars focus on the acquisition of skills and knowledge in the form of formal education, training and instruction as a mechanism to learning (see for example Walz, Elam & Curtis 1993; Ang, Thong & Yap 1997, He 2004; Mathiassen & Pedersen 2005). Others emphasise on the importance of social process of interaction and negotiation between different stakeholders as a mechanism to learning (See Majchrzak & Beath 2000; Huysman 2000; Majchrzak, Beath et al. 2005).

Also with respect to IS development and implementation in developing countries, scholars have emphasised the importance of adopting the learning perspective. For example, Braa (1997) argued that in appropriating, adapting and implementing IS in the context of third world, the challenge is "learning to master IT in its own environment, how to integrate existing systems and supporting geographically spread work routines" (ibid, pp. 142). Braa, Monteiro et al. (2007b) also emphasized the importance of "local process of learning, improvisation and tinkering" (ibid pp. 1-2) in IS design, development and implementation.

In this paper we have chosen to adopt Elkjaer's (2004) 'third way' perspective of learning, which is an attempt to bring a meaningful dialogue between the acquisition and practice-based perspectives by introducing a more pragmatic understanding of organizations as social worlds ¹⁵(see Strauss 1978; Clarke 1991). We argue that adopting this perspective provides a strong analytical lens to understand the learning dynamics, learning mechanisms, tensions and conflicts between different actors belonging to different social worlds in the context of IS development and implementation in general and HIS in particular. The paper draws its empirical material from the context of IS development and implementation in developing countries, specifically from the Ethiopian branch of the global Health Information Systems Program (HISP)¹⁶ network. We describe the development, customization, and implementation between 2004 and 2007 of the District Health Information Software (DHIS) in the Ethiopian public health care system. The analytic focus is on the IS development and implementation seen as an arena for individual and collective learning where different actors from different social worlds and sub-worlds meet, interact and negotiate to deal with challenges, tensions and conflicts. We aim to identify learning that occurred related to the interaction, communication, negotiations and shared action, and have a particular focus on the role of tensions and conflicts as triggers for learning. The paper aims to address the following specific research questions:

- How does learning unfold across different social worlds in the process of developing, customizing and implementing computer-based HIS?
- What is the implication of the learning perspective for IS design and development in the context of developing countries?

The paper is organized as follows: in the next section we present a selective review of the cognitive ("acquisition") and practice-based ("participation") perspectives of learning, before we present the 'third way' and the social world perspectives which has been used as an analytical lens in this study. Section three introduces the research approach and methodology. The next section contains the case description which describes the process of developing, customizing and implementing two distinct versions of DHIS software. Section five presents the analysis and discussion, whereas the last section provides concluding remarks.

2. Perspectives on Organizational Learning

Organizational learning is a field of study used in several disciplines including management science, sociology, psychology, production and operations management, industrial economy, information theory and systems dynamics to mention a few (Shrivastava 1983; Easterby-Smith 1997; Bontis, Crossan, & Hulland 2002). As such, there is little convergence or consensus on what is meant by the term organizational learning (Huber 1991; Kim 1993). The common trait in the majority of definitions is that they consider organizational learning as a process that has to do with transforming information to knowledge (e.g. Argyris & Schon 1978; Filo & Lyles 1985; Huber 1991).

¹⁵ *Social worlds: "are groups with shared commitments to certain activities, sharing resources of many kinds to achieve their goals, and building shared ideologies, about how to go about their business" (Clarke 1991 pp. 131 citing Strauss 1978). The notion of social worlds as such includes individuals, groups and organizations.*

¹⁶ *More information about the Health Information Systems project can be found in (Braa et al., 2004; Braa et al., 2007) and on: www.hisp.info*

The multitude ways in which the notion of organizational learning had been conceptualised and used has created an ‘organizational learning jungle’ that has become difficult to penetrate (Prange 1999). One of the most prominent debates in the literature of organizational learning is, however, the debate between the acquisition (cognitive) and participation (practice-based) approaches. The theoretical basis of this paper mainly lies on the emerging attempts to establish a more meaningful dialogue between the two perspectives. In the following sub-sections, therefore, we will present a brief overview of the acquisition vs. participation perspectives of learning, and then we will present the ‘Third Way’ (see Elkjaer 2004) of organizational learning as our chosen theoretical framework.

2.1 Acquisition vs. participation perspectives of Learning

The acquisition (cognitive) and participation (practice-based) perspectives of learning have informed two influential strands of literature on organizational knowledge and learning, though there has been little exchange between the two traditions (Marshall, 2008). Much of the early literature on organizational learning rests upon an understanding of learning inherent in cognitive based perspectives of learning (Antonacopoulou 2006; Antonacopoulou & Chiva 2007). The cognitive perspective focuses on identifying, noticing, and acquiring knowledge that exists tacitly or explicitly (Gnyawali 1999). Elkjaer (2004) argued that the acquisition perspective “...views the mind as being a container, knowledge as a substance and learning as the transfer and addition of substance to mind” (ibid, pp: 419-20). This form of learning, therefore, mainly focuses on exploiting the already existing information and knowledge through training, instruction, and formal education (Gherardi, Nicolini & Odella 1998). One important limitation of the acquisition (cognitive) perspective in the study of organizations is its individualistic bias (Gherardi, Nicolini & Odella 1998; Antonacopoulou & Chiva 2007). This bias is evident in two tendencies of the cognitive based learning literature: treating organizations as if they are equivalent to individual actors and drawing analogies between organizational and individual cognition; and assuming organizational knowledge and learning as an aggregate of the individual cognition of its members (Marshall 2008).

Due to its focus on individual acquisition of skills and knowledge as its point of departure, the acquisition metaphor is being criticised by many contemporary scholars. For example, Elkjaer (2004) argued that “resting organizational learning upon the metaphor of knowledge acquisition is problematic with regard to understanding and explaining how it is possible to transfer an individual learning outcome to the organization” (ibid pp: 422). Building on the criticisms of the cognitive approaches, Marshall (2008) also noted that “...to the extent that cognitive approaches have relied on models of information processing, it is true that they tend towards a rather static, functionalist and ultimately individualistic portrayal of learning as the passive acquisition of knowledge” (ibid, pp: 414). Huysman (2000) in her part also noted that due to its emphasis on planned and goal oriented learning (as formal teaching and instruction), cognitive based learning perspectives are not suited to encompass situated learning.

Proponents of the participation (practice-based) perspectives, on the other hand, argue that learning should be studied as a process and emphasise on the dynamic, processual and inescapably social and material character of knowing (see for example, Cook and Yanow 1993; Lave and Wenger 1991; Wenger 1998; Gherardi 2000, 2001, 2006; Elkjaer 1999; Gherardi and Nicolini 2002; Nicolini, Gherardi & Yanow 2003; Antonacopoulou 2006). In this way, the focus has been changed from the individual learning to collective learning and from an outcome perspective to a process perspective of learning and organizing.

The participation approach, therefore, takes learning out of the individual mind and formal educational settings and places it into everyday organizational life and work (Elkjaer 2004). Seen from this perspective, learning occurs mainly through conversations, negotiation and interactions between people, rather than within the heads of individuals or organizational systems and structures (Brown and Duguid 1991; Gherardi and Nicolini 2002). So, the participation approach redirects the focus from the information processing and cognitive structure to the process of participation and interaction that provides and sustains the proper context of learning (Gherardi, Nicolini & Odella 1998).

An important strength of the practice-based perspective is that it “...strive to offer a holistic understanding of knowing and learning as dynamic, emergent social accomplishments that are actively situated within specific contexts of practice” (Marshall 2008, pp. 418). Unlike the cognitive approaches that tend to emphasise the context or settings of organizational actions as static; the participation perspective conceptualize context as crucially enacted, whereby its elements are simultaneously influenced on the medium and outcome of social activity (Antonacopoulou & Chiva 2007; Marshall 2008).

However, the participation approach has also its own limitations. Primarily, it is criticized for ignoring the importance of tensions and conflicts as triggers to learning both at individual and collective levels (Mark & Poltrock 2004; Thompson 2005; Antonacopoulou & Chiva 2007); and it often perceives learning “as harmonious, free from conflict, tension and power issues” (Huysman & Elkjaer 2006 pp. 3). Besides, this perspective fails to elaborate on how it is possible to include mind and thinking in order to conduct theoretically informed actions (Elkjaer 2004). Thirdly, as Elkjaer (2004) indicated, “...the ‘how’ and ‘what’ of learning seem to disappear within the broader concept of learning as participation in communities of practice (ibid, pp. 420).”

To this end, different scholars (including Gnyawali 1999; Sfard 1998; Elkjaer 2004; Mark & Poltrock 2004) indicated the importance of creating a sense of common ground between the two perspectives. These scholars further argued that adopting either of these perspectives in isolation will only lead to see part of the picture of what organizational learning entails. The ‘third way’ is, therefore, a theoretical lens that aims to create a common ground between the two perspectives. Drawing on the works of Anselm Strauss (1978) on negotiated order and the social worlds perspective, the ‘third way’ perspective provides a lens to study learning as a result of tensions, conflicts, actions, interactions and negotiations between different social worlds (Huysman & Elkjaer 2006). An overview of this perspective is presented in the following sub-section.

2.2 The ‘Third Way’ as a lens to study learning across social worlds

The ‘third way’ of organizational learning is “an attempt to make a synthesis of the ‘second way’ (i.e. participation perspective) of organizational learning with its understanding of learning as participation in communities of practice by including elements of the ‘first way’ (i.e. acquisition perspective) of organizational learning, learning as acquisition of knowledge as well as analytical and communicative skills” (Elkjaer, 2004, pp. 420). The

basic idea in her synthesis is that "... thinking is instrumental in learning as participation and the learning takes place as a social process" (ibid, pp. 420).

The third way also opens up the way we conceptualize the learning content. While the acquisition approach focuses on the acquisition of skills and knowledge, and the participation focuses on becoming skilful practitioner, within the third way the content of learning is seen as constituting *experience*. Similarly the view on the learning method is expanded; from activities aimed at skills and knowledge acquisition or participation in the daily activities of communities of practice, learning within the "third way" is seen to encompass individual and joint *inquiry* or reflective thinking (Elkjaer, 2004).

The "third way" thus transcends former understandings of organizations as systems or as communities of practice and introduces a more pragmatic view of understanding organizations as social worlds. Within this understanding of organizations, "...individuals and organizations are understood as being mutually constituted and constituting the 'systemic' order of organizational actions and interactions kept together by individuals' and groups' commitment to organizational life and work" (Elkjaer, 2004 pp: 421). Work is understood as coordinated collective action and organizations as social worlds created and maintained by commitment to organizational activities (Clarke 1991; Strauss 1993). Thus, as Huysman and Elkjaer (2006) indicated "... an important feature of the social world is that they are not bounded by geography or formal membership but by the limits of effective communication" (ibid, pp. 7).

The 'third way', by introducing the notion of 'social worlds', opens up an understanding of the organization as neither system nor collective but as social world held together by commitment to organizational situations and events, which can be traced in space and time (Elkjaer, 2004). The social worlds, therefore are not social units or structures, but an organizational life that makes up a recognizable form of collective actions and interactions shaped by commitment to organizational activities (Elkjaer 2004; Huysman & Elkjaer 2006). The social world perspective, therefore, provides the image of organizations as arenas of negotiated orders and learning as a process of collective actions, interactions, communications and negotiations (including conflicts) within and between multiple social worlds (Clarke, 1991).

In this paper, we look the public health care system of developing countries as an arena made up of different social worlds and sub-worlds consisting of heterogeneous actors with diverse organizational commitments. For example, there are multiple global and international actors and stakeholders with varying and sometimes conflicting interests (including donors, politicians, national and regional health care authorities, health care managers, health care providers, educational institutions, software companies, developers and analysts). There are also several health programs and services working to serve particular needs in their respective programs and services. We, therefore, argue that it is relevant to conceptualise learning around DHIS software adoption and implementation as occurring through action, interaction, communication and negotiation between the members of these social worlds.

3. Research Setting and Approach

This section describes the research setting related to the introduction of the DHIS software into the Ethiopian public healthcare system, as well as the research strategy adopted.

3.1 Research Setting: Public healthcare in Ethiopia

The empirical setting for this research is Ethiopia which is located in the North Eastern part of Africa with a total area of 1.1 million km² and a total population of 71 million growing at a rate of 2.7%. More than 85% of the country's population lives in rural areas, which makes Ethiopia one of the least urbanized countries in the world (HSDP III, 2005/06). Politically, the country is a federation of nine National Regional States and two Administrative States¹⁷. These states are further divided into sixty-five zones, five hundred twenty-three districts ('woredas') and around 10,000 'kebeles'.

The public health care system in Ethiopia comprises of the Federal Ministry of Health, Regional Health Bureaus, Zonal Health Departments, and Woreda Health Offices. There are central referral (specialized) hospitals at the federal level, hospitals at regional, zonal and district (Woreda) levels, and Health Centers, Health Stations, and Health Posts¹⁸ at woreda levels. The health care system is largely underdeveloped and under resourced and as a result can provide the basic services to only about 60% of the population. Much of the rural population has no access to modern health care, leading to inability of the health care delivery systems to respond both quantitatively and qualitatively to the health needs of the people. The health delivery system is highly centralized at the regional level with little actual room for local decision making. The healthcare is also delivered in a fragmented way, relying on disease-specific, so-called vertical programs.

This study was conducted within the global Health Information System Program (HISP) which is an action research initiative (Braa and Hedberg 2002; Braa et al. 2004, Braa et al. 2007a). The HISP activities started in South Africa in 1994 as a collaborative action research project between the University of Oslo, Norway and University of Western Cape, South Africa. The aim of HISP is mainly to strengthen the process of designing and implementing effective health information systems (HIS) in developing countries. The specific orientation is to provide "information for action" at the district level where services are provided. To this end, the global HISP network has developed free and open source software called DHIS – District Health Information System.

The first version of the District Health information Software (DHIS) was developed by HISP in South Africa at a tool to support the management of routine health data, i.e. routine activity and epidemiological data rather than patient-based data. The DHIS software was developed in South Africa and through time it was customized and implemented in various countries including India, Mozambique, Malawi, Tanzania, and Ethiopia. HISP was initiated in Ethiopia in early 2003 as a collaborative project between the Department of Information Science, Addis Ababa University and the Department of Informatics at the University of Oslo, Norway. HISP initially sought formal approval from the Federal Ministry of Health, but this failed as the

¹⁷ Tigray, Afar, Amhara, Oromia, Somalia, Benishangul-Gumuz, Southern Nations, Nationalities and Peoples Region (SNNPR), Gambella, and Harari are the regional states; Addis Ababa and Dire Dawa are the two administrative states

¹⁸ Health center serves 25,000 people where as health post serves 5,000 people. Health center serves as a referral health facility for 5 health posts.

Ministry wanted to pursue its own process (that development and implementation of HIS would be carried out by their own experts, and that the ministry's priority was the development of a national HMIS strategy.). Collaboration was instead established with the relatively autonomous regional health bureaus, starting with Addis Ababa Health Bureau where an agreement was signed in December 2003. In 2004 agreements were reached also with four other regional health bureaus in Oromia, Amhara, Tigray, and Benishangul-Gumuz to carry out HIS development and implementation. In 2007 the Federal Ministry of Health announced a bid for tender for a new national HMIS, where DHIS eventually lost to a competitor. Following that, the development activities in the HISP Ethiopia ceased, while actual system use continued while the users awaited the replacement of the software. In this paper we describe the case with an emphasis on the activities in Addis Ababa in the period between 2003 and 2005, as well as the later expansion to other regions and the migration to a new version of the software happening in 2006-2007.

3.2 Research Approach

This study employed a qualitative research approach, based in the interpretative tradition (Walsham 1993), which seeks to understand complex social, technological and organizational issues related to the development, customization, and implementation of information systems in different contexts. As Walsham (1993) pointed out, interpretive research is "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (ibid p p. 4-5). Our research is also informed by the set of principles developed by Klein and Myers (1999) for conducting and evaluating interpretive IS research. They present the principle of interaction between the researcher(s) and subjects and say that "the facts are produced as part and parcel of the social interaction of the researchers with the participants" (Klein & Myers 1999, pp. 74). Our involvement in the domain as supporters of the software projects enabled us a unique access to the processes and rich contextual exposure, but also a prescribed role which limited our coverage. Our relation to the other stakeholders was one of project partners, not independent researchers in an observation role. The interactions, communication and negotiations that are described in the paper are thus a selection that is limited and biased. For instance, in our own narrative of our own projects we are more interested in the positive learning that did happen, rather than on what did not happen.

The study has relied on multiple sources for empirical material. While the overall HISP project understands itself as an action research project, we chose to not frame this study in that way. However, participation and intervention into the process were significant characteristics of the research process in the field. The empirical data presented here was collected by the first author who is an Ethiopian national and a member of the HISP-Ethiopia development and implementation team. As a member of the HISP-Ethiopia team, he participated in conducting situational analysis, customization, implementation, and capacity building activities in different regions and at different administrative levels since the inception of the project in 2003. Apart from the knowledge that comes from different sources during long term exposure in the project, the empirical material for this specific study was collected through semi-structured interviews, observation during meetings and workshops, document analysis and analysis of e-mails communicated through group mailing lists.

3.2.1 Interviews

Interviews were conducted with six HISP-Ethiopia team members, three developers from Oslo and Vietnam, and seven end users of DHIS 1.3 software in Addis Ababa Health Bureau. Questions asked during the interview sessions were open-ended and semi-structured. Some questions were more specifically structured to reflect the learning aspect and the experiences acquired during the customization, implementation and use of the computerised HIS in the Ethiopian context. Besides, participation in the frequent and informal group discussions (during lunch and coffee sessions) with the local development team members was consciously used to explore their learning experiences and to investigate the problems they encountered in the process.

3.2.2 Participant Observation

As an active member of the HISP-Ethiopia project team, the first author of this paper was highly involved in many interventions introduced by HISP including political negotiations, standardization of the data sets and reporting formats, software customization, implementation, and user training. He also participated in meetings, discussions and workshops held with managers at regional and national levels to discuss, negotiate and collaborate in improvising the existing paper-based HIS at different levels of the public health care system in Ethiopia. The issues raised and discussed during those meetings and workshops are reported as data in this research. During those sessions notes were taken which were summarised and rewritten latter. Participation during user training programmes on the basics of computers and the application software (DHIS 1.3) conducted in June and July 2003 in Addis Ababa and Benishangul-Gumuz respectively, and on DHIS 1.4 in Amhara regional state in May 2006 also gave first hand information on the issues discussed, problems encountered and learning experiences both by the domain experts and the trainers about the technology and the domain specific knowledge (including data elements, indicators , reports etc).

3.2.3 Document Analysis

Analysis of existing documents (both printed and electronic) was another source of information. The relevant documents included strategic plans (HSDP III 2005/06), public reports, the formal “Memorandum of Understanding” documents with the involved partners, etc. These documents were reviewed and helped to identify major events, historical decisions made and key actors and their roles. Of specific interest for this study is the archive of electronic mail messages on the HISP Ethiopia mailing list, as well as other relevant lists (there are several mailing lists within HISP). These email messages reflected the discussions and debates within the HISP team (nationally and globally).

4. Case Description

In this section we describe the case study. First we concentrate on the activities in Addis Ababa in the period between 2003 and 2005 which illustrates how learning happens in the meeting between social worlds. Secondly, we describe the learning achievements and challenges related to the expansion to other regions as well as the migration to a new version of the software happening in 2006-2007, which illustrates the way sub worlds are generated and how learning happens within and around them.

4.1 Introducing DHIS in Addis Ababa

As mentioned in section 3.1 collaboration between Addis Ababa University (the Information Science department) and the University of Oslo (Department of Informatics) was initiated in spring 2003. A local HISP Ethiopia team (administratively belonging to Addis Ababa University) of 3 PhD students and 5 Master students were created, and members from this team performed a situation analysis during May to August 2003, before two of them left for PhD studies in Norway between August and December 2003. Upon their return the collaboration between HISP Ethiopia and the Addis Ababa Health Bureau was formalised in the end of December 2003. During January 2004 the HISP team prepared a prototype version of DHIS based on their knowledge from the situation analysis performed. The database was populated with real data taken from two of Addis Ababa's ten sub-cities. In a workshop held on February 4th 2004 the prototype was demonstrated to members of the Addis Ababa Health Bureau. The prototype demonstration was well received, and was followed by a large-scale and intensive process during the next three months (between February and April 2004) of defining a standardized minimal data set. The minimal data set should specify which data items should be collected by health workers and which indicators should be calculated from these data items. This involved several sub-groups working on different parts of the health service, which often are organized as separate, so-called vertical programs. On March 19th 2004 a workshop was held to present the suggested standardized minimal data set. Subsequently to finalizing the data set and customizing the DHIS software, in May - June training was given to 30 health staff during a three-week long period of half-day sessions. After the training implementation started, and by December 2004 the DHIS had been implemented in 11 sub-city health departments, 5 hospitals and 23 health centres. In July 2005 a workshop assessed the results of the first year of using the DHIS, and concluded that the improvements and achievements were significant.

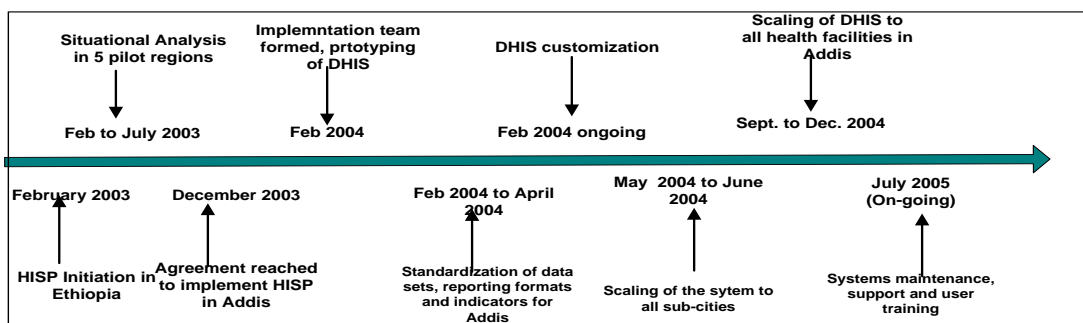


Figure 1: Timeline for DHIS 1.3 Development & Implementation in AAHB

The process of successful DHIS introduction involved the meeting of multiple social worlds, and in this section we focus on how actions, interactions and tensions between the local IS team and the regional health bureau stimulated learning. Concretely this happened in the

context of the prototyping, standardization and customization work since these activities involved negotiations between the diverse social worlds and sub worlds.

4.1.1 Negotiations between different social worlds

When the HISP-Ethiopia team was formed, none of its members had specific knowledge about the healthcare domain, e.g. about the organization of health programs and services, data elements, indicators, reports, and work practices. The engagement in the situation analysis somewhat alleviated this, but also the later activities were significant learning opportunities. However, neither did the staff working in the AAHB know the HISP team or the software (DHIS). In one of the initial meetings in January 2004 the head of the health bureau participated, as well as the heads of vertical programs and the head of the planning and programming department (which is responsible for the HMIS). Three HISP-Ethiopia team members (including the first author of this paper) participated in the meeting. First the HISP-Ethiopia project coordinator gave a brief overview about HISP, both globally as well as the local team, on the proposed strategies for computerization of HMIS, and features and functionalities of DHIS software. Following this presentation several questions were raised from the participants. For example, one health programme manager questioned the HISP team:

“how are you going to make the system practically functional when most of the would be users at different levels of the health bureau are without any background on using computers for information processing and report generation?” (Health Program Manager, January 2004).

One of the HISP-Ethiopia team members replied that capacity development was part of the implementation plan, both training on basic computer skills and on the DHIS software. This was received favourably, and the health bureau staffs were open about the difficulties they were facing with the existing paper-based system. Discussion also touched upon issues related to sustainability and technical support, as well as the possibility for integration with an ongoing project to implement a patient record system. The head of the health bureau concluded:

“...we are happy that you come with such a solution to solve our timely and practical problem of improving the management of health data. HMIS is our priority and we need to improve it.... We are willing to mobilize whatever resources we have including the required manpower, material and financial resources” (Head of AAHB, January 2004).

The negotiations and the acceptance that resulted formed the basis for further practical work. On February 4th a prototype of DHIS version 1.3 was demonstrated to management team members and other staff at the health bureau. The database had been populated with data from two of the 11 sub-cities over a nine-month period, thus reports could be generated based on real data from AAHB. Some standard reports were produced and also the possibility to use pivot tables to generate ad hoc reports was demonstrated. This was greatly appreciated by the management, which as a result endorsed DHIS 1.3 to be customized and implemented at all levels of the public health hierarchy, i.e. both in the AAHB, at the sub-city and at the health facility level. Subsequently the DHIS software (originating in South Africa) was customized. This involved adapting DHIS to the Ethiopian health system's administrative structure and changing the software to refer to the Ethiopian fiscal year period (Ethiopia does not follow the Gregorian calendar of the Western world, but has its own calendar, quite similar to the Julian calendar). Moreover the DHIS software had to be complemented with a new module for registration and reporting of data according to the ICD (International Classification of Diseases) codes; this was locally called the “morbidity and mortality” module. Finally, the actual data elements, indicators and standard reports had to be defined in the system. This

however, involved a process of standardization and harmonization of data elements across various vertical health programs.

4.1.2 Tensions between different social sub-worlds

Following the formal agreement between HISP-Ethiopia and the AAHB, in February 2004 a process of reviewing and standardizing the existing HMIS system started. A number of domain experts from the health bureau were enrolled, including the head of Health Services, Family Health, Disease Prevention and Control, and the team leaders of the IDSR (Integrated Disease Surveillance Response) team, the Tuberculosis/Leprosy team and the HIV/AIDS teams. Also the information, education and communication (IEC) expert, the network administrator at the health bureau, the bureau head and representatives from sub-cities was included, and sub-teams were created to discuss the various domains and program areas.

A significant aspect of their mandate was to standardize existing data elements, indicators and reporting formats. In the next couple of months the various sub-teams reviewed and discussed whether specific data items, reports, and indicators of different health programs and services should be included in the new minimal data set or not. Regular meetings and visits to health institutions were conducted along with the day to day informal face to face discussions and telephone conversations among the team members. On March 19th, 2004 a workshop was organized to discuss the draft standard that was suggested by the teams. Health experts and statisticians from all health facilities, from the sub-city health departments and the health bureau participated together with representatives from different vertical health programs and services of the Federal Ministry of Health, as well as representatives from international organizations. Discussions on the draft standards, deliberations of the changes proposed, and suggestions for improvement or correction were encouraged. These deliberations were not trivial since many crossing interests were prevalent; the requirements fluctuated and were in conflict. The standardization process created a lot of tension among the different participants, each representing health programs and services with particular and different needs. For example, it demanded a lot of effort to convince different health program managers to reduce the number of data elements based on the principle of “information for action.” As one of the HISP-Ethiopia team members indicated:

“... while preparing and demonstrating the prototype using standardised data sets, program managers were fighting to ensure their own respective need on what to be included in the report rather than focusing on the integration and development of standardised regional datasets. We were always forced to negotiate on the importance of having integrated essential data sets” (HISP-Ethiopia team member, July 2004).

Following another round of revision work, the new HMIS standard, comprising minimal data sets, lists of indicators as well as reporting tools was accepted and endorsed. Another account of the process of negotiation between different sub-worlds has been observed during a national workshop held in July 2004 to address the key challenges of developing an integrated HMIS at different levels. As it is reported by Braa et al. (2007a), although the workshop was intended to present a minimal indicator/data set that would provide the basis for developing an integrated HIS, the workshop didn't agree on the suggested data sets due to several reasons including: “most participants, who were representing the range of vertical programs and services, didn't find “their” data in the proposed data set” (ibid, pp. 13).

That this process ended with consensus implies a process of learning where the different participants have managed to negotiate and recognise each others views as legitimate. Also for

the HISP team this process was valuable. Regarding the lessons learned in the standardization process, one of the HISP team members noted the following:

“... the standardization process was the best way to better understand the domain area including the data elements and indicators for each health program and service.... The discussions with in different groups and presentations of different working groups in workshops enabled most of us to be more familiar with the terminologies of the domain and helped us in our effort of designing reports and customizing the software according to the requirements of the users.”(HISP team member, June 2004).

4.1.3 Learning in interactions around an artifact

The work of developing a prototype and customizing the DHIS software created a learning opportunity for both the HISP team members and the participants from the public health domain. For example, while the first prototype was prepared before the new standardised data sets and indicators had been developed, it involved the usage of real data to populate the database. In the process of preparing the prototype, the HISP-Ethiopia team conducted several consultations and discussions with the domain experts to learn about their needs and requirements, and those requirements were incorporated into the software. As the HISP-Ethiopia project coordinator pointed out:

“... since users are not good in precisely telling their requirements, the prototype approach was chosen to identify requirements. The prototype was prepared in consultation with the domain experts using nine months routine data collected from two sub-cities. The prototype helped us to demonstrate to the bureau head, department heads, program managers, domain experts from different levels of the health bureau that the system can support different functionalities including the ICD module. This enabled management and users to have a clear understanding and vision on what is intended to accomplish.....For the reporting format, we use pivot table to identify user requirements. Users were happy to see the sample reports generated using their own data and it ensured them that they can generate reports using pivot-table functionality of the software.” (HISP-Ethiopia coordinator, June 2004).

When the prototype was demonstrated in the February workshop it was intended to create practical knowledge and awareness among the public health staff on the functionalities and potential benefits of the DHIS software. The presentation of the prototype in the workshop itself created an opportunity for further discussion and mutual learning on the weakness and strengths of the software. As one of the HMIS coordinators at the regional health bureau indicated:

“... the prototype demonstration created a better environment for us not only to comprehend the system and express their needs and requirements but also to appreciate and develop interest in the DHIS software. Besides, this process also helped to easily identify inconsistencies and problems (such as existence of similar data elements in multiple reporting formats with different purposes) in the current reporting formats. We were really happy to see the sample reports generated using our own data, and understand that we can generate ad-hoc reports easily using pivot table reports. (HMIS Coordinator, AAHB, July 2004).”

The prototype demonstration was also a useful learning process for the HISP team. The discussions during the demonstration helped them to see that the solution chosen for the new Morbidity and Mortality module was inefficient. As one of the HISP-Ethiopia team members indicated:

“... based on the comments received from the domain experts, some changes were made on the newly designed ICD code module. Some of the changes made were: adding

ICD description column in addition to the ICD column in the report, mimicking the paper format for Morbidity & Mortality data entry and reporting forms, cutting long names of fields to fit the data entry window... (HISP team member, June 2004)”

The standardization and prototyping process centred on the DHIS software was thus an important arena for interaction and learning between health domain experts and IS experts.

4.1.4 Implementation and Post-implementation developments

Following training in May and June 2004, the customized software was implemented in all 11 sub-city health departments, 5 hospitals and 23 health centres. When the software was deployed and actual usage started, new issues emerged as the HISP team met other members of the health sector.

The training aimed to build capacity of health workers, statisticians and managers at different levels. Training sessions covered the basics of computers usage as well as skills with Windows, Microsoft Word, Excel and Access. Then the training focused on the functionality and usage of the DHIS software. The training was evaluated positively, and all of the trainees requested the regional health bureau to speed up the implementation process in their respective sub-cities and health facilities. Besides, the training sessions also served as an excellent opportunity for the end users to offer their opinions to the HISP team on the system. As the then HISP-Ethiopia coordinator pointed out:

“...the training given for health workers and health managers on the basics of computers as well as on data processing, reporting, and compiling of graphs has created an excellent ground for interaction and communication between end users and HISP team members to improve some weaknesses on the system particularly in improving the report lay-out and the interface of the system for morbidity and mortality module.” (HISP-Ethiopia coordinator, July 2004)

When the data collection for this paper ended (November 2007) there were two and half years’ report generated electronically and the software was being used for data management activities at all levels of the AAHB and had been integrated into day to day routines of health workers, statisticians and managers at different levels. Assessment of the software’s impact showed that there was significant improvement with regard to the reporting performance and in making the required data available for analysis and decision making at different levels of the health bureau.

4.2 Expansion and migration to a new version of the software

In this section we describe how the successful implementation process in Addis Ababa formed the basis for further work. First we describe how the HISP team built on the experience they gained during the implementation in Addis Ababa. After that we focus on the tensions created and the resulting learning within the HISP Ethiopia team as a second (and radically different) version of the software was introduced.

4.2.1 Wider deployment of version 1.3

HISP Ethiopia and the software system gained legitimacy through the successful process in Addis Ababa. Subsequently similar initiatives were started also in other regional states including Oromia, Tigray, Amhara and Benishangul-Gumuz. The first author was involved in adapting DHIS, user training and implementation process in Amhara and Benishangul-Gumuz regional states. Below we exemplify how the success in Addis Ababa and the learning outcomes had an impact on the expansion to those regions as well.

In Benishangul-Gumuz, in June 2004, DHIS version 1.3 as well as the standardized data collection and reporting tool which was customized for Addis Ababa health bureau was used as

a point of departure. Then, the software was demonstrated to a workshop representing participants from the regional health bureau, vertical program heads, zonal health department heads and district health office managers. The standardized data collection and reporting tool was presented and used as a point of discussion to develop the new regional data set and reporting formats. Similarly in Amhara, the customized software and standardized data sets and reporting formats were used to initiate the project in the region. In this process the lessons learned in Addis Ababa was invaluable to the HISP team. The resulting standardised data set, the customized system of version 1.3 as well as the training materials developed was taken as points of departure when introducing DHIS in the new pilot sites. Also in these regions the software was customized to fit with local needs. For instance, there were differences with respect to organizational levels. Where Addis Ababa has four hierarchical levels (national, regional, sub-city and health facility levels), both Amhara and Benishangul-Gumuz have five levels (national, regional, zonal, district and health facility levels). Besides, there were differences in the type of data collected between Addis and the other regional states. For example, due to its high altitude, Addis Ababa does not have malaria, and malaria data is not collected. In the other regional states the malaria burden is higher. Here the malaria department is often one of the core departments, and data is routinely collected and reported to higher levels for either intervention or prevention purposes. During the implementation in these states, the process of integrating the data collection and reporting system of different vertical programs was conducted by the actors from each respective regional health bureau. In this process the experience gained from Addis was used as a driving force to undertake the process of standardization and software customization.

4.2.2 A new version of the DHIS software is introduced

The version of the DHIS which was deployed in Addis Ababa as well as the other regions was version 1.3. During 2005 there were discussions on how to conduct the migration from DHIS version 1.3 to the new version 1.4, but these plans did not get realised. While the DHIS was a Free and Open Source application, it was built to work on the Microsoft Access database, thus requiring the installation of Microsoft Windows and the Office suite. Moreover, the development of the software was concentrated in South Africa and was overly dependent on a single developer. In May 2004 development of a new platform independent version (called version 2.0) started in Oslo, Norway. The aim was to create a globally distributed team of both Northern and Southern developers that employed technologies and frameworks from the Open Source community. The resulting system should be modular, platform independent and offer web enabled functionality (Staring and Titlestad, 2006). The development of this version was pushed by a strong wish for a truly open source version of DHIS from the health authorities in the Indian state of Kerala, one of the HISP sites where the political and ideological commitment to OSS is particularly strong. Milestone 1 of DHIS version 2.0 was released on February 15th 2006, and immediately deployed in Kerala.

Already in March 2006, when two Oslo professors visited Ethiopia, discussions started whether HISP Ethiopia should migrate to the new platform-independent version (i.e. version 2.0). They proposed the idea of piloting DHIS 2.0 in two of the regions where much progress in DHIS 1.3 deployment had not yet been achieved (Tigray and Benishangul-Gumuz). Following this suggestion an open discussion through the HISP-Ethiopia mailing list started. Most of the Ethiopian PhD students (who had been involved in the implementation of DHIS version 1.3) were in Oslo at that time, while Master students (who had been exposed to the new version during their courses in Oslo) were back in Ethiopia preparing for their master projects. In general the group who had experience with implementation of version 1.3 were sceptical

and mustered arguments related to the infrastructure required for adopting the new system, the lack of skill and capacity of the local team to customize the new version, and the immaturity of the new version. Below some arguments from these email discussions are presented:

- *HISP researcher1: “limit the implementation of DHIS 2.0 to Tigray and implement DHIS 1.4 in Benishangul. DHIS 2.0 is being updated frequently and the current strategy proposed for Ethiopia requires more resources (specifically support) to incorporate the changes if we want to scale the system to many sites.”*
- *PhD student1: “Limit the piloting of DHIS 2.0 only in Tigray regional state at the level of the regional health bureau until the software matures and the local development and customization team gains experience on the technologies and tools used to develop the software.”*
- *PhD student 2: “Because of infrastructural problem, it may be difficult to implement DHIS 2.0 in Benishangul. It is better to go for DHIS 1.4 in Benishangul. I don’t think it is appropriate to pilot DHIS 2.0 in Tigray since their previous position is to wait and see the decision of the Federal Ministry of Health on the new data sets and reporting formats before any action.”*
- *Professor: “...my suggestion is to think about possible strategies to address the challenges, rather than taking the view that it is not possible.”*

Following this email discussion another meeting was held on March 31st 2006 in the HISP-Ethiopia office, where all the MSc students, HISP researchers and a professor from University of Oslo were present, but most PhD students were absent. The goal was to decide on which version to implement in both regions. After a thorough discussion on the alternatives proposed, consensus was reached to go for the implementation of DHIS 2.0 both in Tigray and Benishangul-Gumuz.

4.2.3 Learning about the new version

Then, a new HISP-Ethiopia development team comprising of the four Ethiopian Master students (studying at UIO), as well as one Master student from Vietnam, two staff members (graduated Master students now recruited as HISP researchers), and one full-time developer was formed. The task was to carry out the development and customization of DHIS 2.0 as per the requirements of the Ethiopian public health care system. The team’s technical knowledge and experience was diverse. The new Masters students had a relatively better background on Java frameworks and other DHIS 2.0 core technologies and Open Source Software development tools from the courses they took at the UIO. The two HISP researchers had been actively working on the customization and implementation of DHIS 1.3 in different regions and had no formal training or exposure to Java frameworks and other DHIS 2.0 development tools. The different experiences and skills was the source of divergence on which strategy to pursue. The group of Master students were more enthusiastic and pushed for the immediate transition to the new version, while the experienced implementers was more reluctant on the immediate transition approach and demanded a step-by-step transition. They also advocated a primary focus on building the capacity of all the local team on Java frameworks and associated DHIS 2.0 core technologies, as one member indicated:

“...before we start the customization process, we need to build the capacity of the technical team in order to customize the software to meet the requirements of the Ethiopian context. The HISP team members in Addis, for example, are not familiar with many of the DHIS 2.0 core technologies and Java programming. This needs some time before we understand and start customization.” (HISP-Ethiopia team member, August 2006).

In contrast, when one of the Master students was asked about his views on the customization of DHIS 2.0, he stated that:

“...personally, I am convinced that DHIS 2.0 must be implemented in Ethiopia in whatever way. I believe it is the best solution for routine data management and will solve many of the problems related to routine data management.”

Several efforts were made to bridge this gap in technical competency, views and commitments among local developers. Initially, the local developer offered an in-house training on the basics of Java for both the Master students and the HISP researchers. The Vietnamese developer (who was also a fellow Master student at UIO) stayed in Ethiopia for about three months and contributed in building the technical competency of local HISP team members. This was done through hands-on guided training using the DHIS 2.0 core technologies. His support and presence with the local team for a relatively long time span significantly contributed to initiate the customization of DHIS 2.0 by the Ethiopian team. In addition two developers from the University of Oslo also stayed in Ethiopia for about two weeks in August 2006 and assisted the local team in incorporating the indicator module, finalizing the morbidity-mortality module and import-export module for the Ethiopian version of DHIS 2.0. They also provided intensive in-house training to the local team on Java and associated DHIS 2.0 core technologies.

In addition to the on-site support, the local team also got support through the online electronic collaboration platform (the mailing lists and a collaborative “wiki” web site). The team worked in collaboration with globally distributed team of HISP developers (mainly from the University of Oslo and from the HISP Vietnam team). However, the online support was of limited value due to poor internet connectivity in Ethiopia, which also inhibited the up- or downloading of codes and development tools, such as libraries. This was problematic since a lot of the Open Source frameworks and tools are connectivity-dependent. As one of the respondents indicated:

“... it was really difficult and still is to download different milestones from the remote server in Oslo when new versions are released. For example it took many days to download milestone 2 from the remote server. When we have technical difficulties we always depend on the technical team in Oslo to upload source code for us.” (HISP-Ethiopia team member, August 2006).

The lack of one responsible person in the global mailing list to answer questions posted by local team members was also found to be a problem. By November 2007 the DHIS 2.0 was fully customized and all the necessary modules (including mortality and morbidity) were incorporated. However, implementation had not yet started in any of the pilot sites. This was mainly due to the decision of the Federal Ministry of Health (FMoH) to offer the national bid to computerise HMIS nationally to a local software company. As such, since DHIS 2.0 has not been tested in the field, there was no practical interaction, communication, and learning between people from the public health domain and the HISP development and implementation team in the same way as it was experienced in the case of DHIS 1.3 customization and implementation.

5. Analysis and Discussion

This section is organized into two main parts. First we identify and analyse issues influencing the learning process. Then we discuss the utility and practical implications of the learning framework in the context of IS development and implementation in developing countries.

5.1 Learning in the meeting between social worlds

The case presentation of this study illustrates that the development and implementation of computer-based IS in the context of developing countries is a complex and dynamic processes of collaboration and learning among different stakeholders. We conceptualize these stakeholders as belonging to multiple social worlds and sub-worlds. The case also showed that knowledge is neither an entity nor physical resource to be transferred nor something simply embedded in organizational processes and routines. It is rather a result of recurrent and on-going interaction and negotiation of different stakeholders with different backgrounds, experiences and knowledge who are engaged in adapting, modifying and improvising existing systems, tools routines and practices.

In this sub-section, our discussion is organised around three crucial issues that influenced the learning process in our empirical case. These three issues are: Interaction between the IS and public health domains, technological capacity at individual, group and organizational levels, and organizational buy-in and commitment towards the technology.

5.1.1 Interaction between IS and the public health domains

As it is indicated in the introduction of this paper, IS development and implementation is not only a process of designing and implementing technical artefacts, it is also a process of communication, negotiation and mutual and interactive learning. The relative success achieved in the DHIS 1.3 customization and implementation in Addis Ababa hinged on the creation of a strong collaboration and learning environment between the technical HISP implementation team and users in regional health bureau, sub-cities and health facilities. The agreement and subsequent activities created multiple opportunities for communication, negotiation and learning among different actors both from the health and the IS domains. These activities created situations that facilitated joint inquiry and thus mutual learning. The participants from the two domains learnt from each other through a combination of formal and informal mechanisms, such as presentation, group-meetings and discussions, interaction around technical support, and also face to face dialogues and discussions, telephone conversations etc.

As it can be observed from the empirical material, the activities to improvise the routine health data management activities created learning opportunities of different kinds during the different phases of the change process. Initially the developers learnt about the organization and practice of health services, and also about existing data elements and indicators of the reporting system. Later they had the opportunity to iteratively develop and test the software and refine it based on feedback from the health domain participants. Similarly the health workers got the opportunity to learn about the technology's features, functionalities and potentials in improving their day to day work practices. Health workers acquired knowledge about new ways of data entry, analysis and report generation using DHIS 1.3 software and its different functionalities. They also learnt how to use different data analysis tools such as Excel to generate reports with graphs and charts. The users shared experiences and hints among themselves during training sessions and workshops, and we may say that learning at the

organizational level is evidenced by the successful implementation and use of the standardised and customised software in Addis Ababa.

In the development and customization of DHIS 2.0 the same kind of learning was not experienced. This was mainly due to lack of practical action in reaching out the domain experts in customizing and implementing the software. The software was not tested in a practical work environment, partly as a result of the slow pace of customization and development and partly as a result of the larger political processes at federal level. However, we see in this phase the collaborative actions pursued to facilitate learning between the two sub-worlds, the “old-timers” and “newcomers” in the team, in order to create learning on Java frameworks and associated open source technologies. Following the debate, some of the “old-timers” shared in the co-located, hands-on work that created opportunities for joint inquiry and learning.

5.1.2 Multiplicity of learning levels

Defining the units of analysis (levels of learning) has been one of the most debated issues in the literature that links IS with organizational learning (see for example Walz et al. 1993; Stein & Vandenburg 1996; Robey Boudreau & Rose 2000; Majchrzak, Beath et al. 2005). This paper adopts the social worlds perspective of learning which encourages a more holistic understanding of learning across multiple levels (individual, group, organizational and even inter-organizational). By adopting this perspective, we underscore that it is through the inter-relationships between levels that learning emerges out of the possible actions, interactions and negotiation of individual, group or organizational actors.

The inter-level dynamic and interaction was critical to build the skills and knowledge of both IS professionals and health domain experts and to ensure the successful adaptation and implementation of the system at different levels. That DHIS 1.3 was successfully implemented in all public health care institutions in Addis Ababa was partly as a result of the technical competency and negotiation skills of the main developer and project coordinator. However, it was equally critical to improve the technical skill and knowledge of end users through formal training and on-site technical support. The combination of voluntary adoption and management support made this learning spread across all the user sites, and was a significant reason for its success. Thus, in the case of DHIS 1.3 implementation, the technological capacity of both developers and end users was developed and cultivated both at individual, group and organizational levels. We argue that such multi-level learning is necessary to ensure the successful implementation and long term utilization of an IS.

If we look to the case of DHIS 2.0 it is evident that the poor technical competency among the HISP-Ethiopia local development team posed challenges to the development, customization and implementation process. We do see a partial learning process, where some team members acquired an understanding and mastering of Java frameworks and core technologies through capacity building efforts (both by local and global developers) and through practical hands on exercise (learning by doing). However, this mastery and knowledge was not equally distributed within the team, and contributed to the failure to fulfil implementation deadlines in the pilot sites (Tigray and Benishangul regional states). Instead of exploiting the already existing skills and knowledge of the team and adapt it to fit the new requirements, it seems as the existing, previously successful competency was not engaged with the new direction and was not drawn upon. While learning occurred within the IS social world (at least for parts of the team), the previously successful models for joint learning between healthcare and IS was not replicated.

This is in contrast to the expansion of version 1.3 to other regional states, where the previous experience were successfully utilized and constituted a valuable basis.

5.1.3 Organizational commitment and buy-in

Organizational buy-in, support and commitment to an IS are generally seen as important factors for successful implementation and institutionalization of the system. More specifically, the support of senior management towards the system to be implemented is essential in providing insight on the visions, goals, and organizational benefits of the system to organizational members. This support of senior management can only be achieved by allowing them to understand and learn about the features of the system and its potentials in making a difference to improve existing work practices and routines. Failure to achieve sustained top management support would have a far-reaching impact on the success of the project. The empirical findings of this study revealed how the support and learning of top management in Addis Ababa Health Bureau contributes to the successful adaptation and deployment of DHIS 1.3 in all public health institutions of the region and the lack of similar support at national ministry of health influenced the fate of DHIS 2.0 and overall HISP initiatives in Ethiopia.

It is evident that in the case of DHIS v.1.3 in Addis Ababa the management support, availability of resources and positive views towards the new system facilitated the implementation process. More specifically, the role of the head of the regional health bureau starting from the inception of the project is worth mentioning. His insights and visions to introduce change to the existing fragmented routine health management information system, his readiness to learn on new approaches and technological alternatives proposed by the HISP team members, his commitment to allocate financial and material resources to facilitate the implementation process and above all his participation and engagement in all important meetings and workshops held gave impetus for other management members of the health bureau and sub-city and health facility levels to fully participate in the change process. The commitment and learning of top management on the importance of the new system, created a fundamental opportunity for both the domain experts and the IS people to collaborate, interact, negotiate in dealing with existing as well as emerging problems and challenges.

However, a similar level of organizational buy-in and learning process was not observed in DHIS 2.0 development and customization process mainly due to two reasons. Primarily, the decision, to customize and implement DHIS 2.0 in the Ethiopian context was a spontaneous decision that did not take the context into account in terms of: existing systems (i.e. earlier versions of DHIS being implemented in different regional states and how to make a transition to the new system), availability of the required skills and knowledge to do the customization at a local level, and commitment of local HISP team members to the new initiative. Secondly, the persistent reluctance of the top management of the planning and programming Department of the Federal Ministry of Health towards HISP's initiatives made it difficult to implement the system at national level. The lack of local skill and knowledge to customise the system as well as the lack of consensus on the introduction of DHIS 2.0 on top of existing versions contributed for slow process of development of the different modules specifically required for the Ethiopian context and also gave an excuse for the Federal Ministry of Health to reject DHIS 2.0 by giving the following reasons: 'DHIS 2.0 software failed to fulfil some of the basic requirements set by the Ministry'; 'DHIS 2.0 is currently under development and its implementation is incomplete, with some functions awaiting implementation'; and 'there is no evidence that the skills to modify the source code are readily available in Ethiopia'.

5.2 The Social Worlds perspective on IS development

Our study confirms that IS development and implementation initiatives in developing countries can benefit from insights of the social worlds perspective of learning. More specifically, we argue that adopting the social worlds perspective as our analytical lens is essential to develop a holistic view of the levels of learning (units of analysis) in IS design and development; and to conceptualize organizations as arenas for actions, interactions, and learning unbounded by function or geography. Each of these aspects is discussed in further detail in subsequent sections.

5.2.1 Develop a holistic view of the levels of learning

There is little agreement among the IS scholars who are linking IS development with the learning perspective with regard to the units of analysis (levels of learning) (see for example Huysman 2000; Pirinen and Pekkola 2006). Many scholars (for instance Robey, Boudreau & Rose 2000; Stein & Vandenbosch 1996; Lyytinen & Robey 1999) emphasize the organizational level of learning rather than the individual, group, and inter-organizational levels. Others (such as Newman & Nobel 1993; Majchrzak & Beath 2000; Zhong & Majchrzak 2004) support the idea that it is the individual or group of individuals who acts and learn in an organizational framework. There are also some IS scholars (such as Curtis Kranser & Iscoe 1988; Huysman 2000) who considered learning as a multi-level process that occurs at individual, group and organizational levels.

The social worlds perspective, on the other hand, helps to conceptualize organizations as learning environments and individuals, groups and organizations as learning entities. By doing so, the social worlds perspective brings the relations between individuals and organizations to the fore and opens up an understanding of the organization as neither a system nor communities of practice but as social worlds held together by commitment to organizational actions, interactions, and negotiations. The social worlds perspective, therefore, provides a holistic view by overcoming the need to differentiate between the various levels. When the unit of analysis is defined based on shared commitment and joint communication, we are not confined within organizational boundaries or specific levels. Thus this perspective allows us to capture learning where it happens, which in our case was through the dynamic inter-relationship between actors belonging to different organizational levels.

5.2.2 Organizations as social worlds unbounded in terms of boundary and function

The social worlds perspective also helps to understand organizations as “arenas of coordinated collective action in which social worlds emerge as a result of commitment to organizational activities” (Huysman & Elkjaer 2006, pp. 3). As Clarke (1991) indicated, a social world is a unit of collective action. Similarly, Shibutani (1955) also argued that the most prominent bounding factor for any social world is not spatial or organizational structure or formal membership but the limits of effective communication. Unlike most organizational theories, the social worlds perspective understands organizations as having fluid boundaries (Mark and Poltrock 2004) which are connected through communication and not by geographical boundaries or functions.

The social worlds perspective also brings the notions of conflict tensions into the fore. As Huysman and Elkjaer (2006) indicated, organizational commitments to different actions, activities and values is the source of tension and conflict among different actors participating in different social worlds (sub-worlds).

The social worlds perspective therefore can be used as an alternative analytical lens for studying and understanding the tensions, conflicts, actions, interactions and negotiations of diverse actors involved in the design development and implementation of IS in different contexts. Mark and Poltrock (2004) for example adopted the social worlds perspective to understand technology diffusion in the context of distributed organizations. They argue that the social worlds perspective provides a useful insight to explain groupware adoption in a distributed organizational setting. Fitzpatrick (2000) also applied the social worlds perspective to study work practice boundaries in electronic communication and argued that since work practices are carried out by members of a social world, “work practice boundaries and the transformational effects of crossing those boundaries by means of electronic communication are best interpreted in relation to social world centers, or in activity theory terms, the object of the activity” (ibid pp. 116). Huysman and Elkjaer (2006) introduced the social worlds perspective to study the process of learning within and between two communities stemming from different social worlds. They concluded that the notion of social worlds provides an alternative theoretical lens to study organizational learning mainly due to its strength in pointing out the value of organizational tensions and conflicts derived from different commitments to actions, activities and values.

In this paper, we also tried to reveal that HIS development and implementation is an arena where multiple social worlds with diverse cultures, practices and interests interact and negotiate. It is an arena composed of heterogeneous actors from national, regional and district health institutions, international and local donor agencies, academic and research institutions, diverse IS development teams, consultants. Different actors could also be members of different social worlds for example one individual actor could be a member of a working group to standardize existing data sets and reporting format; a task force to conduct situational analysis, a team to customize the software etc. Participation to any world (sub-world) is no longer be constrained by physical boundaries, the different human and organizational actors are rather connected through communication, interaction and negotiation. Participation in multiple social worlds that are unbounded by geographic boundary or function creates an opportunity different actors to be part of the learning process that is beyond their own social world (sub-worlds). For example the IS development team, due to their participation in different social worlds of the public health domain in the process of data standardization, user training and implementation; they pass through a learning process and understand about the specific issues and problems of the public health domain.

6 Implications and Conclusions

This section presents the theoretical and practical implications as well as concluding remarks of this paper.

6.1 Implications for IS development in developing Countries

Building on the theoretical insights from the social world perspective of learning (Elkjaer 2004; Mark and Poltrock 2004; Huysman & Elkjaer 2006), this paper underscores the importance of the learning approach to IS development and implementation. Adoption of the social worlds perspective of learning has implications for a range of issues within the development and implementation of computer-based information systems in the context of developing countries. It confirms our understanding of IS development and implementation as not a mere technical process; moreover it emphasizes the importance of inter-disciplinary

learning and underscores the need for organizational commitment and support to make and IS development initiative successful. We will now discuss these three aspects more detailed.

6.1.1 IS development is not a mere technical project

There are several scholars (see Kling & Scacchi 1982; Walsham 1993; Loranzi, Riley et al. 1995; Atkinson & Peel 1998; Berg 1999; Braa & Hedberg 2002; Braa, Monteiro & Sahay 2004) who stress the importance of organizational issues in IS design, development and implementation. As Berg (1999) noted getting ICT based health care information systems “to work in established practices appears to be a politically textured process of organizational change, in which users have to be put center stage” (ibid pp. 88). As such, the process of developing such systems is a socio-technical process that involves heterogeneous network of human and non-human actors (Braa, Monteiro & Sahay 2004) rather than a mere technical process to be undertaken by qualified system designers and developers. The socio-technical approach emphasizes that human and non human (including technologies, organizational norms, rules, practices, and politics) actors are closely interwoven and aligned towards achieving a common goal (Berg 1999).

Similarly, making ICT based health care information systems to work in practice in the context of developing countries which is usually characterized by poor physical and technical infrastructure, inadequate human resource capacity, weaknesses in management and service delivery, multiplicity of programs and work practices, and absence of policy guidelines to implement new systems and improve existing ones is not a mere technical process. This is a socio-technical transformation process in the sense that it involves human actors with diverse background, interests and values; organizational rituals, rules, and practices; competing technological solutions; and political and power issues that influence different decisions and actions.

The findings of this paper revealed that the development and implementation of computerized HIS in the context of the Ethiopian public health care system is a complex socio-technical change and learning process that involves diverse human and non human actors, multiple work practices, and political interests. Because of the political nature of the change process as well as because of the multiplicity of work practices mainly related to the fragmented information processing activities of vertical health programs, the process was influenced by tensions and conflicts. As such, the process of introducing the different versions of DHIS software was not a mere technical process of adapting and implementing the new technology in health care institutions. It was, rather a process characterized by an on-going and incremental process of change where both systems developers and domain experts (managers and health workers) interact, negotiate to address tensions and conflicting interests, and values among the different stakeholders participating in the change process. The technology has been shaped and appropriated through mutual learning and shared understanding of the different stakeholders from multiple social worlds (sub-worlds).

6.1.2 Facilitate inter-disciplinary learning

Several IS researchers (including Lyytinen 1987; Curtis, Kranser & iscoe 1988; Boehm 1991; Braa, Monteiro & Reinert 1995; Zhong & Majchrzak 2004; He 2004; Bondarouk 2006) argued that IS development and implementation is an inter-disciplinary learning and communication process whereby IS designers and developers learn about the non technical context where the system is to be developed and implemented and the domain experts would in turn learn about the features and functionalities of the hardware and software. More specifically, Braa Monteiro et al. (2007b) noted that due to the inextricably interlinked nature

of the context of use and software development, customization and implementation; it is crucial to facilitate mutual and interactive learning between public health and IS domain experts.

Similarly, the findings of this study revealed that, although other socio-technical factors (such as political commitment and managerial support, availability of resources and infrastructure, human resource constraints) have an impact on the outcome; an effective inter-disciplinary learning within and between different actors from the IS and public health social worlds influences the success or failure of the development and implementation. There are two examples from the case study that clearly show the importance of creating an environment that allows inter-disciplinary interaction, negotiation and learning among different stakeholders involved in introducing computer-based HIS in the Ethiopian public health care system. The first is the case of customizing and implementing DHIS version 1.3 in Addis Ababa health bureau. This initiative was conducted by establishing meaningful collaboration and support between the IS and public health domain experts. As it can be seen for the empirical material, this initiative was a success mainly because of the meaningful interaction and synergy created between HISP-Ethiopia team members and the managers and health workers at different levels of the public health care system of the Addis Abba Health Bureau. It is important to note here, that the inter-disciplinary learning did not only happen between the IS and the public health domain, but also between different groups with different interests and orientations within the public health domain. Without learning between these groups, a standardized common solution would not be able to define. Previous IS research on learning have focused on the need for IS professional to learn from users and vice versa, and may not have emphasized how IS projects may necessitate and trigger learning processes also between different groups within the social world of the user domain.

The second case with respect to inter-disciplinary learning is the initiative to develop, customize and implement DHIS 2.0 with better functionality compared to earlier versions. This initiative was terminated before it achieved any results on the ground. This can be attributed to both internal (lack of technical competency among local developers; lack of common vision on when, where and how to implement; lack of transition strategies on how to integrate the new version with older versions, and poor technical and physical infrastructure) and external factors (including failure to establish meaningful interdisciplinary dialogue and collaboration, lack of political support mainly by the Federal Ministry of Health). While learning happened within the IS world, truly inter-disciplinary learning did not occur as in the case with DHIS version 1.3.

6.1.3 Underscore the need for organizational commitment and support

The IS literature has the notion that the support of organizational commitment and the support of top management has significant impact on the adaptation, implementation and even use of computerized systems in organizations (see for example, Doll 1985). The impact of organizational commitment and management support towards the new IS can be manifested in different ways including: create a smooth working and communication environment for the IS team, allocation of sufficient resources for the project, developing positive attitude towards the system among the user community etc.

The findings of this paper also showed that organizational commitment and the support of management at different levels is crucial not only during the initial stages of customizing the software, but also at latter stages of implantation and post-implementation.

6.2 Concluding Remarks

This paper has addressed the link between learning and IS development and implementation in the context of the health care sector of developing countries. From the case description it can be concluded that joint action creates an arena where different social worlds meet with a shared commitment, and thus joint action facilitates learning across these different social worlds. As can be observed from the experiences of DHIS 1.3 customization, implementation and scaling in Addis Ababa, the practical action and implementation played a significant role in the learning process by enabling individuals and groups from both the health and IS domains to learn from their day to day activities and actions. However, in the case of development and customization of the new version (DHIS 2.0) there was no such joint action between the health domain and the (new) IS experts, and a similar process of mutual learning did not take place. However, also in the case of the new version we observe learning within the IS team, started by a dispute around the advisability of introducing a new version. Members of the previous team were exposed to a new technological paradigm, and through guided hands-on training they learnt to master a new programming language as well as work with new and framework and tools. In this case the version 2.0 of the software was the object of the shared activity which facilitated learning, just as version 1.3 drew together the health experts and the IS experts in the previous phase. This time however, the participants in the joint action were not health experts, but the international community of developers around the software.

The motivation for this paper is linked to the orientation of the IS discourse on learning. While the notion of learning is applied in many IS studies, often the term is used to denote how local learning and best practices are shared and transferred. The dynamics of the process has received less attention, as well as the specific conditions and situation where learning is facilitated. This paper has described more in detail how tensions and conflicts among different actors with diverse backgrounds, interests, and values trigger learning while adapting and appropriating computer-based HIS in public health settings of a developing country.

References

- Aarts, J., Peel, V. and Wright, G. (1998). Organizational issues in health informatics: a model approach. *International Journal of Medical Informatics*, 52, 235-242.
- Addison, T. and Vallabh, S. (2002). Controlling software project risks - an empirical study of methods used by experienced project managers. *Proceedings of SAICSIT Port Elizabeth, South Africa, 16-18 September 2002* (pp:128-140).
- Ang, K.-T., Thong, J., and Yap, C. S. (1997). IT implementation through the lens of organizational learning: a case study of insurer. *Proceedings of the eighteenth International Conference on Information Systems, December 15-17, 1997, Atlanta, Georgia, USA* (pp. 331-348).
- Antonacopoulou, E. P. and Chiva R. (2007). The Social complexity of organizational learning: the dynamics of learning and organizing. *Management Learning*, 38(3): 277-295.
- Antonacopoulou, E. P. (2006). Modes of knowing in practice: The relationship between learning and knowledge revisited. IN: B. Renzel, K. Matzler and H. H. Hinterhuber (eds.) . *The Future of Knowledge management*, pp. 7-28. London: Palgrave.
- Argyris, C. and Schön, D. A. (1978). *Organizational learning: A theory of action perspective*. Reading, MA, USA: Addison Wesley.
- Atkinson, C. and Peel, V. J.(1998). Growing, not building, the electronic patient record system. *Methods of Information in Medicine*, 37: 206-310.
- Berg, M. (1999). Patient care information systems and health care work: a sociotechnical approach. *International Journal of Medical Informatics*, 55: 87-101.
- Boehm, B. (1991). Software risk management: principles and practices. *IEEE Software*, 8, 32-41.
- Boland, R. J. (1978). The process and product of system design. *Management Science* 24, 887-898.
- Bondarouk, T. V. (2006). Action-oriented group learning in the implementation of information technologies: results from three case studies." *European Journal of Information Systems* 15, 42-53.
- Bontis, H., Crossan, M. & Hulland, J. (2002). Managing an organizational learning system by aligning stocks and flows. *Journal of Management Studies*, 39(4), 437-469.
- Braa, J. (1997). Use and design of technology in third world contexts with a focus on the health sector: case studies from Mongolia and South Africa. Faculty of Mathematics and Natural Sciences, University of Oslo, PhD Thesis.
- Braa, J and Hedberg, C. (2002). The struggle for developing district health information systems in South Africa. *Information Society*, 18, 113-127.
- Braa, J., Hanseth, O., Heywood, A., Mohammed, W., Shaw, V. (2007a). Developing health information systems in developing countries: the flexible standards." *MIS Quarterly*, 31, 381-402
- Braa, J.; Monteiro, E.; Sahay, S.; Staring, K.; & Titlestad, O. H. (2007b). Scaling up local learning-experiences from South-South_North Networks of shared software development. *Proceeding of IFIP 9.4, Sao Paulo, Brazil*.
- Braa, J., Monteiro, E. and Reinert E. S (1995). "Technology transfer vs. technological learning: IT-infrastructure and health care in developing countries." *IT for Development*, 6(1): 15-23.
- Braa, J., Monteiro, E. and Sahay, S. (2004). Networks of action: sustainable health information systems across developing countries." *MIS Quarterly*, 28, 337-362.

- Bratteteig, T. (1997). Mutual learning. Enabling cooperation in systems design". In Braa, K. & Monteiro, E. (eds): Proceedings of IRIS'20, 9-12 August, Hankø, Norway, (1-20).
- Brown, J. S. and Duguid, P. (1991). Organizational learning and communities of practice: toward a unified view of working, learning, and innovation. *Organization Science*, 2: 40-57.
- Clarke, A. (1991). Social worlds/arenas theory as organizational theory. In Maines, D. (ed.) *Social organization and socials process: essays in honor of Anselm Strauss*. Hawthorne (NY): Aldine de Gruyter, pp.119-158.
- Cook, S. D. N., & Yanow, D. (1993): Culture and organizational learning. *Journal of Management Inquiry*, 2(4): 373-390.
- Curtis B., Krasner, H., Iscoe, N. (1988). A field study of the software design process for large systems." *Communications of the ACM*, 31, 1268-1287.
- Doll, W. J. (1985). Avenues for top management involvement in successful MIS development. *MIS Quarterly*, 9(1): 17-35.
- Easterby-Smith, M. (1997). Disciplines of organizational learning: contributions and critiques. *Human Relations*, 50(9): 1085-1113.
- Elkjaer, B. (1999). In search of a Social Learning Theory. In M. Easterby-Smith, L. Araujo and J. Burgoyne (eds.) *Organizational Learning and the Learning Organization*, London, Sage.
- Elkjaer, B. (2004). Organizational learning: 'The Third Way'. *Management Learning*, 35(4): 419-434
- Fiol, C. M. & Lyles, M. A. (1985). Organizational Learning. *Academy of Management Review*, 10(4): 803-813.
- Fitzpatrick, G. (2000). Centers, peripheries and electronic communication: chaging work practice boundaries. *Scandinavian Journal of Information Systems*, 12: 115-148.
- Gherardi, S. (2000). Practice-based theorizing on learning and knowing in organizations: An introduction. *Organization*, 7: 211-24.
- Gherardi, S. (2001). From organizational learning to practice-based knowing. *Human Relations*, 54(1): 131-139.
- Gherardi, S. (2006). *Organizational knowledge: the texture of workplace learning*. Oxford, UK: Blackwell.
- Gherardi, S. and Nicolini, D. (2002). Learning in constellation of interconnected practices: canon or dissonance? *Journal of Management Studies*, 39(4): 419-436.
- Gherardi, S., Nicolini, D. and Odella, F. (1998). Toward a social understanding of how people learn in organizations. *Management Learning*, 29: 273-297.
- Gnyawali, D. R. (1999). Inter-organizational learning dynamics: Roles of networks on knowledge creation. Available at URL: [http://notes.lancs.ac.uk/pub/ol3.nsf/0/2900de6351042d958025676100505844/\\$FILE/Gnyawali.pdf](http://notes.lancs.ac.uk/pub/ol3.nsf/0/2900de6351042d958025676100505844/$FILE/Gnyawali.pdf) (Accesed November 2008)
- HDSP-III (2005/06). Health Sector Strategic Plan. Federal Ministry of Health, Addis Ababa, Ethiopia.
- He, J. (2004). Knowledge impacts of user participation: a cognitive perspective. *Proceedings of SIGMIS April 22-24, 2004 Tucson, Arizona, USA* , pp. 1-7.
- Huber, G. P. (1991). Organizational learning: The contributing processes and the literature. *Organization Science*, 2(1): 88-115.
- Huysman, M. (2000). Rethinking organizational learning: Analyzing learning processes of information systems designers. *Accounting, Management and Information Technologies* 10, 81-99.

- Huysman, M. & Elkjaer, B. (2006). Organizations as arenas of social worlds: towards an alternative perspective on organizational learning? Proceedings of the International Conference on Organizational Learning, Knowledge and Capabilities (OLKC) University of Warwick, Coventry, UK. Available at URL: <http://www.olkc.net/> (accessed June 2008).
- Kim, D. M. (1993). The link between individual and organizational learning." *Sloan Management Review*, Fall 1993, 37-50.
- Klein, H.K. and Myers, M.D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1): 67-93.
- Kling, R. & Scacchi, W. (1982). The web of computing: Computer technology as social organization. *Advanced Computing*, 21.
- Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Lorenzi, N. M.; Riley, R. T.; Ball, M. J.; Douglas, J. V. (eds.). (1995). *Transforming health care through information: Case studies*, Springer, New York.
- Lyytinen, K. (1987). Different perspectives on information systems: Problems and solutions. *ACM Computing Surveys* 19, 5-46.
- Lyytinen, K. and Robey, D. (1999). Learning failure in information systems development. *Information Systems Journal*, 9, 85-101.
- Majchrzak, A. and Beath, C. M. (2000). Beyond user participation. A method of learning and negotiation during systems development. Workshop on redefining the organization roles of Information Technology in the Information Age. Zmud R. W. (ed.). Norman, OK.
- Majchrzak, A., Beath, C. Lim, R.A. and Chin, W.W. (2005). Managing client dialogues during information systems design to facilitate client learning. *MIS Quarterly*, 29, 653-672.
- Mark, G. & Poltrock, S. (2004). Groupware adoption in distributed organization: transporting and transforming technology through social worlds. *Information and Organization*, 14: 297-327.
- Marshall, N. (2008). Cognitive and practice-based theories of organizational knowledge and learning: incompatible or complementary? *Management Learning*, 39(4): 413-435.
- Mathiassen, L. & Pedersen, K. (2005). The dynamics of knowledge in systems development practice. Proceedings of the 38th Hawaii International Conference on System Sciences. 3-6 January 2005, Big Island, Hawaii, USA, 11 p.
- Newman, M. & Nobel, F. (1990). User involvement as an interaction process: A case study. *Information Systems Research*, 1, 89-113.
- Nicolini, D.; Gherardi, S.; & Yanow, D. (eds) (2003). *Knowing in Organizations. A practice based approach*. Armonk, NY: M.E. Sharpe.
- Pirinen, A. & Pekkola S. (2006). Different perspectives on learning in Information System development. Proceedings of IRIS'29, the 29th Information Systems Research Seminar in Scandinavia, Elsinore, Denmark, August 12-15 2006.
- Prange, C. (1999). Organizational learning: desperately seeking theory. In M. Easterby-Smith, L. Araujo & J. Burgoyne, *Organizational Learning and the learning organization: developments in theory and practice*. London: Sage publications.
- Robey, D., Boudreau, M.C., Rose, G.M. (2000). Information technology and organizational learning: A review and assessment of research. *Accounting, Management and Information Technologies*, 10, 125-155.
- Scott, J. E. and Vessey, I. (2000). Implementing enterprise resource planning systems: The role of learning from failure. *Information Systems Frontiers*, 2, 213-232.

- Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 27(2): 4-13.
- Shrivastava, P.A. (1983). Typology of organizational learning systems. *Journal of Management Studies*, 20, 1-28.
- Shibutani, T. (1955). Reference groups as perspectives. *The American Journal of Sociology*, 60(6): 562-569
- Starling K. and Titlestad, O. (2006). Networks of open source health care action. Proceedings from the IFIP Working Group 2.13 Foundation on Open Source Software, June 8–10, 2006, Como, Italy.
- Stein, E. W. and Vandenbosch, B. (1996). Organizational learning in advanced systems development: opportunities and obstacles. *Journal of Management Information Systems*, 13, 115-136.
- Strauss, A. (1978). A social world perspective. In *studies in symbolic interaction*, volume 1, edited by Norman Denzin. Greenwich, CT: JAI press.
- Thompson, M. (2005). Structural and epistemic parameter in communities of practice. *Organization Science*, 16(2): 57-91.
- Walsham, G. (1993). *Interpreting Information Systems in Organizations*. Chichester, England: John Wiley and Sons.
- Walz, D.B. Elam, J.J. and Curtis, B. (1993). Inside a software design team; knowledge acquisition, sharing and integration. *Communications of the ACM* 36, 63-77.
- Wastell, D. (1999). Learning dysfunctions in information systems development: Overcoming the social defences with transitional objects. *MIS Quarterly*, 23, 581-600.
- Wenger, E. (1998). *Communities of practice: Learning, Meaning and Identity*. Institute for research and Learning, Cambridge University Press.
- Zhong, J. & Majchrzak, A. (2004). An exploration of impact of cognitive elaboration on learning in ISD projects. *Information Technology and Management*, 15, 143-159.