

An institutional perspective on health information systems' standardization: multiple case studies

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Submitted as partial fulfillment of the degree
Doctor Philosophiae (Ph.D)

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September 2016

Dedicated to my mother and Meazy.

Acknowledgements

First and foremost, I would like to use this opportunity to express my gratitude to my dear husband and my best friend, Kristoffer Fossum. I wouldn't be able to focus on my work or complete my PhD had it not been for your all-round support. You have been great in taking care of the family and in giving me moral support.

This work would not be possible to accomplish without the insightful guidance of my supervisors, Prof. Margunn Aanestad and Prof. Ole Hanseth. I am deeply grateful for the supervision in general and for orienting me to relevant literature. I am thankful to Prof. Eric Monteiro for commenting on my upgrade document and the first draft of the thesis. I thank HISP founders, extenders and sponsors (especially UiO) for laying the groundwork to collect empirical materials from multiple settings. I extend my special gratitude to Prof. Sundeep Sahay for being an excellent academic mentor throughout my studies.

I am indebted to my co-authors Sundeep, Johan, Abyot, John and Zegaye. I am particularly indebted to Abyot Asalefew for the friendship and for the many interesting socio-academic discussions.

Thanks to Murod for the update on the current project status of Tajikistan. All other informants from Ethiopia, India and Tajikistan are highly appreciated. The support I received from the Department of Informatics has been instrumental for the completion of this work. In line with that, I am especially thankful to Prof. Fritz for encouraging me to finish despite some difficulties.

Last but not least, I would like to thank my parents, sisters, and in-laws for the support, care and encouragement. Jonas and Aron, our sons, thanks for continuously reminding me of the fun part of life and for the many drawings that I should take to my workplace ☺

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List of abbreviations and acronyms

ADB	Asian Development Bank
CHC	Community Health Center
DHIS	District Health Information Software
ehealth	Electronic Health
eHIS	electronic Health Information Systems
ETC	Ethiopian Telecommunications corporations
FOSS	Free and Open Source Software
GIS	Geographical Information System
HIS	Health Information System
HISP	Health Information System Program
HMIS	Health Information Management Information systems
HMN	Health Metrics Network
ICTs	Information and Communication Technologies
IS	Information Systems
ISO	International Organization for Standardization
IT	Information Technologies
KAP	Knowledge Attitude and Perception
M&E	Monitoring and Evaluation
MCIT	Ministry of Communication and Information Technology
MDGs	Millennium Development Goals
MOH	Ministry of Health
NANDA	North American Nursing Diagnosis Association
NGO	None Governmental Organizations
NORAD	Norwegian Agency for Development Cooperation
PEPFAR	The United States President's Emergency Plan for AIDS relief
PHC	Primary Health Care
PhD	Doctorate of Philosophy
PSI	Population Service International
SC	Sub-Centres
SDGs	Sustainable Development Goals
TB	Tuberculosis
USAID	United States Agency for International Development
WHO	World Health Organization
CRIS	Current Research Information System
EpiInfo	Epidemiological Information

Abstract

This thesis aims to improve our understanding of standardization within the domain of health information systems (HISs) by studying how institutions enable, constrain and shape the process. It shifts the focus from actor (stakeholders) orientations of standardization studies to institutions. The study was conducted as multiple case studies in three research settings - Ethiopia, India and Tajikistan within the Health Information System Program (HISP). HISP is a professional network, which is engaged in health information systems strengthening activities in developing countries using open source software called District Health Information Software (DHIS).

The study is a qualitative research following interpretive and elements of critical research traditions. It is interpretive in a sense that researchers did not go out to find out facts about standardization but to understand the situated meanings of stakeholders regarding the phenomena. The critical stance comes from the action research of HISP, in which researchers, in addition to understanding the phenomenon from the points of view of the stakeholders, attempt also to change the phenomenon. This action intervention helps researchers to identify historical and contextual factors that constrain and enable the interventionists' efforts. Data was mainly collected through participant observations, interviews, and document reviews.

The study was conducted in two phases from 2007 to 2009 that provided the main research findings and from January 2015 onwards. At the later phase, limited case revisits were conducted to understand what has happened to the cases since the first round of data collection.

The main argument of the thesis is that network effects as standard diffusion mechanisms cannot fully explain standardization in public sectors. Network effects assume a bottom-up approach and increase in the installed base as a basis for standard formation, diffusion and institutionalization. However, in the public health sector of developing countries where decision-making is centralized and there is less competition for market share, institutional mechanisms are more prominent but not the only ones. Thus, concepts from neo institutional theory were used to explore how institutions constrain, enable and shape HIS standardization. The institutional analytical framework by Scott (2001) was used to examine the constraining and enabling role of institutions in the adoption of DHIS. The findings show that in addition to the regulative, normative and cultural-cognitive institutional pillars, technology as a fourth pillar plays an important role in standardization. Given these findings, the thesis argues that network effect is a complementary concept to institutional analysis of standardization.

The other main argument is that when there are intermediary institutions such as HISP in standardization, the process is contingent upon the overlap between the institutional context of the intermediary unit and the institutional context of the health organization. When standardization involves technological solution, the process is also influenced by the nature of the technological solution that standardizes and facilitates the standardization of other types of standards.

The findings of the study specifically show that institutions influence standardization process in three ways:

1. When informal constraints (i.e., norms, values, perceptions, shared assumptions) are not addressed, and the gap between the formal and informal institutions is not overlapped.
2. When competing and dominant institutional logics among stakeholders are not recognized and strategies are not devised to reconcile them in a mutual learning process.
3. When the standardization process cannot gain input legitimacy from relevant stakeholders, such as National Health Ministries, due to misalignment with the existing institutions such as the regulative, normative and cultural-cognitive institutions of the country.

The study suggests the need to conceptualize standardization as institutional change, which is a broad two-staged process of de-institutionalization and re-institutionalization that is filled with small-scale transitions. Institutional change requires:

1. Strong management commitment that is aware and willing to overcome routine and resource constraints
2. Understanding and learning dominate heterogeneous logics in the standardization process.
3. Recognizing standardization not as a static and closed process but as an open, inclusive and continuous process that follows an adaptive approach.
4. Network building both from formal and informal relationships
5. Modularized and flexible standards for bringing institution-sensitive small-scale changes.

The thesis provides theoretical and practical contributions. The first theoretical contribution is the conceptualization of standardization as institutional change. The other theoretical contribution extends the institutional analytical framework by Scott (2001) to also contain a technological element. It also adds upon the literature on information systems failure by looking at the temporality and multidimensionality of failure in standardization. Practically, it contributes to the future practices of standardization in health organization and to the future practices of the Health Information System Program (HISP).

Chapter 1 Introduction

This thesis is aimed at developing an institutional theory informed understanding of standardization in the context of Health Information Systems (HIS) based on four case studies from three developing countries¹- Ethiopia, India, and Tajikistan. Developing countries refers to the World Bank list of countries with low and middle-income economies in which these three countries are included. The study was conducted as part of the Health Information System Program (HISP). This program² has been engaged in collaborating with countries to improve the health information systems using open source generic software called DHIS (District Health Information Software).

This chapter gives an overview of the research that is discussed in greater detail in the next chapters. I begin by introducing HIS standardization and the need for taking an institutional perspective to study this process to enable me to position this research within the existing IS standardization studies. Following that, I present the empirical setting in which the study was situated. An overview of both conceptual and research approaches is also provided. At the end, I pinpoint the theoretical and practical contributions of the thesis that are further elaborated on in Chapter 7. Research articles used for building up the research are listed at the very end of this chapter.

1.1 Background and statement of the problem

In spite of the cultural and historical differences of developing countries, the established value for health data has been limited to sending routine reports upward in the health hierarchy “to satisfy the needs of the bureaucracy” (Byrne & Sahay, 2003, p. 238). This value is a reflection of the past health care arrangement of countries, which was centralized, compartmentalized, and based on curative care. As a result, the information systems in health care organizations have been disease specific with little coordination among the systems. The devolution of government power to districts and the focus on preventive care through the primary health care approach has subsequently required redefinition and improvement of the Health Information Systems (HISs) to support evidence-based local decision-making processes. To this end, the HIS needs to be comprehensive with all the fragmented HIS instantiations integrated through standardization of the data, the tools, and the procedures. In the decentralized health care arrangement, district health administration offices are required to prepare budget proposals to the district councils and city administration not to the Ministry of Health (MOH) (Aiga, Kuroiwa, Takizawa, & Yamagata, 2008). This new health arrangement necessitates establishment of another legitimate value for health data, which is using information for local monitoring and evaluation that needs

¹ http://data.worldbank.org/about/country-and-lending-groups#Lower_middle_income

² Recently, the main health sector focus of the program has been expanded to include supporting Monitoring and Evaluation activities of other sectors as well as NGOs. However, the scope of this study is limited to HISP’s action research in the health care sector of developing countries.

standardization and integration for its materialization. Accordingly, HIS has been the focus of national and international health care reforms for the past two decades. However, the HIS reforms are making little impact in addressing their main agenda, which I call the shift from “ceremonial value” of health data to using information for local decision-making processes. Improving the data quality is one of the core components as data that are not used at the local level but simply reported are often poor in quality (Braa, Heywood, & Sahay, 2012). This in turn requires the use of appropriate Information Communication Technologies (ICTs) making the reform rather complex, as they have to also deal with introducing technological solutions with corresponding capacities to utilize them effectively. This makes the nature of the ICTs an additional agenda of the HIS reform, which one of the cases in this thesis deliberate in detail under the notion of HIS standardization by taking empirical evidences from Kerala and Ethiopia. The nature of technology plays a role for its adoption and further assimilation (Bala & Venkatesh, 2007) adding another layer onto the needed HIS standards.

The Health Information System Program (HISP) is a network of HIS and related professionals. It has been actively working towards achieving the vision of “data for action” through collaborating locally with the public sectors of developing countries and with other donor and none governmental organizations. The program has extensively studied and intervened in the HIS of developing countries; albeit the shift of focus from an aggregate system, to one that is patient based and now m-health. The results of the studies show HIS improvement in developing countries is hardly achieved with the mere introduction of Free and Open Source Software (FOSS) in a given country, even though it has been an important driver for the sought change (cf. Braa and Sahay, 2012). This is because changing HIS is changing the deeply embedded institutions and their implications to capacity and infrastructure. Institutional studies recognize changing the HIS as a battle against the opposite institution’s norms, values, culture and shared assumptions that have determined the rules for the existing HIS work and are persistent in their nature (Scott, 2001). Changing such institutions cannot be achievable with the often short-term donor funded projects and with the existing weak coordination capacity of the public health organization to give projects continuity. One of the early action research outputs of HISP documented the HIS situation and the inertia of the existing institutions for improving HIS work in Mongolia and South Africa as follows:

When I have discussed the need for local analysis and use of information to support a primary health care policy the objective has been to change the content, direction and use of information..... such a proposed strategy will be difficult to implement since the current and ‘opposite’ practice is buried in conventional rules for organizing (Braa, 1997, p.129)

After two decades of HIS intervention within HISP, the inertia of the status quo has been highlighted in integrating the HISs of Zanzibar (Sheikh, 2015). However, encouraging positive outcomes have been observed in this case after fifteen years of continuous effort. The poor existing information culture, heterogeneous actors, the role and responsibilities of individuals involved in

the HIS work, and the strict hierarchical nature of the health care sector have all been recognized as the institutional characteristics of HIS that have been shaping the standardization and institutionalization processes of HISP and the Zanzibar MOH (ibid.). This sort of phenomenon has led to the conceptualization of HIS as a socio-technical configuration (Braa & Hedberg, 2002; Williamson, Stoops, & Heywood, 2001). The values, beliefs, norms, formal rules, and the assumptions that are taken-for-granted within these configuration, change the trajectory and outcomes of the processes thus requiring the unpacking and understanding of them to harness the enabling institutions and alleviate the constraining ones, while at the same time adapting the standard to the institutional context.

One of the key issues that is treated as a socio-technical undertaking for its realization involves the notions of HIS standards and standardization that this thesis is intended to deliberate in-depth by analyzing how institutions shape the process.

Standards are “an agreed-upon way of doing something.... [denoting] a uniform set of measures, agreements, conditions, or specifications between parties” (Spivak & Brenner, 2001, p.16). In technical terms, standards are technical specifications to ensure the compatibility of components to the interface of larger systems or subsystems (Hanseth, Monteiro & Hatling, 1996). From these definitions, we can infer standardization to refer to the process of reaching an agreed upon way of doing things through negotiation, imposition or approval. Within the study of HIS, standards are agreed upon health information procedures (i.e., the way data are collected). They also refer to the content of HIS (i.e., the metadata and indicators). In addition, HIS needs standardized tools (i.e., electronic and non-electronic resources that serve for data collection, processing and presentation) (Braa & Hedberg, 2002; Jacucci, Shaw, & Braa, 2006; Braa, Hanseth, Heywood, Mohammed, & Shaw, 2007b). This classification is based on what should be standardized in HIS, which I am addressing in this thesis. Moreover, standards also commonly refer to technical specifications that enable interoperability and message exchanges among electronic data collection and storage devices (Fomin, Keil, & Lyytinen, 2003; Braa & Sahay, 2012).

In the context of the aforementioned classification, HIS standardization in developing countries has been described as a bottom up participatory process and the standards need to be flexible to be adapted to the context they are being adopted (Braa & Hedberg, 2002; Braa, et al., 2007; Jacucci et al., 2006). Accordingly, my usage of HIS standardization denotes a process by which agreed upon uniform procedures, data and tools are formed, diffused and used in health care organizations following an adaptive process. A technology is viewed as a standard tool when it is a “dominant design” in a given context (Narayanan & Chen, 2012). Standardization is change in the various institutions of HIS including the norms, the culture and supportive rules and regulations with respect to the technological tools, the content and the procedures. Regulative institutions are particularly significant in relation to the ability of HIS to draw upon data from all sources including non-health sector and private organizations (WHO, 2008, p. 18).

The need for HIS standards in developing countries can be summarized in the following four points. First, standardized health data are needed to monitor and compare the health progress at all levels to allocate the limited resources effectively. This need has been well demonstrated during the progress monitoring of the Millennium Development Goals (MDGs) till the year 2015 and it continues to be vital in achieving the current health related Sustainable Development Goals (SDGs). Without uniform datasets, indicators, procedures and tools, comparing health outcomes is impossibility. Therefore, countries need to focus on standardization and integration to measure their progress towards national and international targeted goals. In addition, MOHs are now responsible for implementing health programs through the common basket fund. This shifts the focus of donor agencies to monitoring and evaluation of their program implementation that in turn requires standardized HIS, which provides quality data (Aiga, et al., 2008). However, the governments of many developing countries are not capable to conduct data collection and analysis in a sustainable way, and they are dependent on surveys conducted by external assistance (ibid.). Second, standards facilitate data exchange across the health hierarchies. Integrated health information is essential for proper information sharing and exchange of data between information systems within and across organizational units (Braa et al., 2007b). Third, a uniform technical standard tool, for example, DHIS, may help to decrease costs associated with maintenance and learning how to use a product by allowing greater scale of economies (Saloner & Farrell, 1985). It may also reduce complexity-associated risks by reducing system variety to a manageable size (Schneberger & McLean, 2003). Finally, a standard tool also serves as a boundary object to align the heterogeneous actors towards a common strong and comprehensive HIS if coordinated well by national health ministries (Nyella & Kimaro, 2016). As such, DHIS can be viewed as both a standard and a means for establishing the other standards (i.e., data and procedure) by enabling cooperation among stakeholders.

Despite the relevance of standards, the HIS in most developing countries is largely characterized as cumbersome and fragmented. Many attempts at implementing standards in general have largely failed, either partially or fully with regard to producing the promised results (Botzem & Dobusch, 2012; Braa & Sahay, 2012). Although the HMN frameworks for standardized and integrated HIS are included in national plans, their implementations have been problematic. This is partly due to the lack of recognition as to the importance of HIS, resulting in standardization receiving less attention (WHO, 2008) and partly due to other institutional and infrastructural issues. Standardization is the most salient challenge in HIS both at micro- and macro-level (Aiga et al., 2008). At micro-level, there are no readily available strategies by MOHs in clearing the redundant data collection tools once external agency initiated programs are closed. At macro-level, even though global health partners are flexible in the indicators they use when they initiate new programs, countries introduce ad-hoc disease specific HIS with little coordination with the existing HIS. This is due to interest in being able to “attract the partnerships by increasing more indicators in the reports” (ibid., 2008, p. 5). This situation compromises the data quality and creates a burden on the health practitioners and administrators.

However, the existing literature is skewed towards a technical specification kind of standards (cf. Fomin, et al., 2003; Hanseth & Bygstad, 2015), giving scant emphasis to the non-technical standards despite their importance in increasing the much sought after data quality, data use culture, and information exchange in health care sector. This study intends to contribute to this existing literature by focusing on both technical and non-technical aspects of standards and it further explores the notion from an institutional perspective.

Theoretically, standardization has been studied taking an economic perspective signifying the role of network effects, path dependency and lock-in (Hanseth, 2000; Arthur, 1989; Farrel & Saloner, 1985; Kartz & Shapiro, 1985). This perspective has institutional implications; however, it is not explicitly stated within standardization studies. Even though the above economic concepts are at the core of HIS standardization, they fail to capture the full standardization phenomenon in the public health sector. For example, Hanseth and colleagues discussed the self-reflexive (i.e., fragmentation) end result of EPR (Electronic Patient Record) standardization process in a Norwegian hospital (Hanseth, Jacucci, Grisot, & Aanestad, 2006). As shown in their case, the original intention of the standard making; which is the creation of a single solution based on common information needs ended with producing more paper records. This side effect was a result of a new legal requirement for detailed paper records from professional groups previously not obliged to maintain a patient record. Apart from the regulative issues, the existing work practice, which was highly dependent on paper information flow for communication and coordination, contributed to the increment of the paper formats. This case clearly shows the opposite role of the entrenched institutions on changing the existing EPR organizing. Applying an economic perspective only would not be helpful for making standards work in public sectors. In the language of institutional theory, this scenario requires understanding of the regulative institutions as a constraining element and sensitivity in changing the existing EPR norms.

In simple terms, standardization is changing the way we do things so that we do it in a uniform manner for its accomplishment, which can produce the opposite outcome during implementation because of existing institutions (Sandholtz, 2012). Hence, an institutional perspective on standardization is required. Such studies have received little attention in IS studies. Realizing this knowledge gap, there was a call in an international journal to complement the economic perspective with institutional analysis (Lyytinen & King, 2006). In addition, the systematic literature review on technology standards by Narayanan and Chen (2012, p. 1395) recommend institutional theory inspired study of standardization recognizing the knowledge gap in the current literature. I seek to contribute to those who responded to these calls by taking a multiple case analysis highlighting institutional influences. With an increasing institutional influence on standardization, there is a need for a more comprehensive theoretical undertaking (both institutional and economic perspectives) that can drive future research efforts (ibid.).

Accordingly, with a general objective of exploring how institutional studies inform standardization and attempting to provide an alternative approach for studying standardization in public sectors, this thesis seeks to respond to the following research question:

- *How can institutions enable, constrain and shape HIS standardization in a developing country context?*

To respond to this question I will look into how the health organizations in the four cases responded to the normative pressure from HISP. In Chapter 2, I will discuss the various institutional pressures that drive change in organizations.

1.2 Personal motivation

My personal motivation stems from my HIS practical standardization experiences. I was part of HIS reform in Addis Ababa, Ethiopia under the HISP action research framework. I participated both as a student and fulltime employee. In collaboration with the region health bureaus, we made HIS standards. While Addis Ababa Health Bureau (AAHB) adopted the standards, it failed to get institutionalized at the Federal level and also experienced limited diffusion to other regions. Following that, I represented HISP as an Addis Ababa University employee when the Ethiopian Federal Ministry of Health announced a bid for national standard eHIS. HISP participated by presenting the DHIS2, which was not accepted by the MOH. Responses for the rejection implied the Free and Open Source nature of the software, which we thought could be valuable for countries like Ethiopia, played a role against the intention. Therefore, I started working in the area of HIS standardization for my PhD study with the intent of understanding the practical problems HISP Ethiopia went through. To that end, in this thesis the challenges of HIS standardization have been examined as challenges that emanate from various institutional aspects and the contrast between the nature of the software and the institutional context in which it is intended to operate.

1.3 Empirical settings

As has been mentioned above, my specific research is framed within the broader umbrella of the HISP initiative, which has been ongoing in two phases in Ethiopia. The first phase, which was a partnership between HISP and Regional Health Bureaus, ran from 2003 to 2007. The second phase, which is a national initiative, started from July 2015 onward to pilot test the DHIS2 and considers it as a national standard based upon the results of the pilot. The empirical material from the first phase of the Ethiopian project is used for developing paper I. Materials from the second phase are used to support arguments during the write up of this thesis and in paper IV. The second empirical setting is the Gujarat state of India. My role in the Indian HISP work was purely as a researcher, unlike the Ethiopian project in which I was involved in the actual work of reforming the HIS. Paper III and IV were developed using data from fieldwork in India. Moreover, part of the empirical material for this thesis came from Tajikistan's HIS reforming activities. The work in

Tajikistan started in 2008 and I had an action researcher role at the beginning of the project. The result of this work is reported in paper II. The main HIS strengthening activities in Tajikistan have now come to an end with the MOH of Tajikistan taking full ownership from January 2016.

1.4 Conceptual approach

In order to make sense of the empirical materials collected, I draw upon concepts from neo institutionalism of institutional theory. Institutional theory explains the nature of institutions; that they are multifaceted, the process of institutional change - that institutions arise, diffuse, and survive, and the institutional pressures that lead to institutional change - coercive, mimetic and normative. *Institutions*, as the basic building blocks of the theory, refer to the rules that govern human actions and they appear in the form of formal written regulations, moral obligations, or personal beliefs (North, 1990; Scott, 2001). Institutions reduce uncertainty by structuring our way of doing things (North, 1990, p.3). In this sense, standards can be seen as institutions and that they are formed using other institutions.

By taking an institutional perspective on standardization, I conceptualize standardization as institutional change. In this process, deinstitutionalization of existing normative, regulative and cultural-cognitive institutions happens while new institutions are formed. Standardization requires the active work of institutional entrepreneurs - be it organizations or individuals. This work is constrained and enabled by institutions such as incompatible logics of the entrepreneur and the organization that needs change. They are also influenced by the existing knowledge in the domain area. The formal rules or shared assumptions also have their share of effect on the entrepreneurship. Bringing institutional change also requires legitimation of the action from prominent actors, which in turn legitimizes the standard in order to gain regulatory power (Slager, et al., 2012). Institutional change “consists of marginal adjustments to the complex of rules, norms, and enforcements that constitute the institutional framework” (North, 1990, p.83).

Moreover, I used the concept of “social capital” in explaining my empirical experience on integration of fragmented health information systems in India. This concept informs us that integrating information systems is not only a matter of making IT solutions interoperable or having one solution as a standard but also a matter of having formal and informal social networks that are based on trust and mutual benefits. This concept emphasizes the role and the significant contribution of institutional entrepreneurs in mobilizing resources that are particularly relevant in resolving the bootstrapping and adaptability problems in standard formation and diffusion (Aanestad & Jensen, 2011; Hanseth & Lyytinen, 2010).

1.5 Research approach

The research mainly followed an interpretive case study (Walsham, 1993; 1995). It also has some elements of critical stance since attention was given to the historical context and the subsequent efforts by action researchers to change the situation (Orlikowski & Baroudi, 1991). For example, while the case from Ethiopia clearly shows the action researchers' criticality towards the existing HIS situation and the subsequent change process by the HISP Ethiopia team, the study from Tajikistan brings up the issues of history and institutional continuation challenging the HISP effort to change the status quo. The critical stance complements the main interpretive research tradition the research followed. The study is a multiple case study of HISP's HIS standardization taking the health organization as a unit of analysis. Hence, the study is about the process and outcomes of the HISP interaction with the health organizations in the four cases. I conducted this research in two phases: from January 2007- July 2009 and 2015. The main research was conducted in the first phase. In the second phase, I did limited revisits of the cases to understand what has happened since the first round of data collection. Data was collected as being part of the action research and as an outside observant in these settings. Interviews and participant observations were used as main data sources, and those were complemented with document review and email correspondences. Details about the research approach are given in Chapter 4.

1.6 List of papers included in the thesis

Paper I: Mekonnen, Selamawit Molla, & Sundeep Sahay. "An institutional analysis on the dynamics of the interaction between standardizing and scaling processes: a case study from Ethiopia." European Journal of Information Systems 17.3 (2008): 279-289.

Paper II: Sahay, Sundeep, Johan Sæbø, Selamawit Mekonnen & Abyot Gizaw. "Interplay of institutional logics and implications for deinstitutionalization: case study of HMIS implementation in Tajikistan." Information Technologies & International Development 6.3 (2010): 19-32.

Paper III: Mekonnen, Selamawit Molla, Sundeep Sahay, & John Lewis. "Understanding the Role of Social Capital in Integrating Health Information Systems." Journal of Health Informatics in Developing Countries 9.2 (2015).

Paper IV: Mekonnen, Selamawit Molla, and Zegaye Seifu Wubishet. "An Institutional Perspective to Understand FOSS Adoption in Public Sectors: Case Studies in Ethiopia and India." American Journal of Information Systems 4.2 (2016): 32-44.

1.7 Research contributions

The thesis contributes theoretically and practically to the domain of information systems with a particular focus on developing countries. It has two main contributions:

- To provide an institutional perspective on HIS standardization using concepts from institutional theory, which will be used to complement the widely adopted economic perspective, and
- Based on this theoretical understanding of standardization, the thesis seeks to suggest some practical implications to deal with standardization in HIS strengthening initiatives.

1.8 Structure of the thesis

The rest of the thesis is organized as follows:

In the next chapter, I will present a literature review on standardization and on institutional theory. At the end of the chapter, I will discuss how standardization can be related to concepts of institutional theory. This discussion is used to propose an integrated framework for analyzing standardization as institutional change.

In chapter three, the research settings where case materials were drawn upon are elaborated. The chapter is also used to give background information on HISP and the DHIS software.

Chapter four provides detailed discussions of the research approach the thesis followed. The data collection techniques and how data were analyzed are also described in this chapter.

In chapter five, an extended summary of the four papers is provided. The extended summary served as a basis for the analyses and discussions in chapter six. The last chapter is dedicated to contributions and conclusions.

Chapter 2 Literature review and conceptual approach

In this chapter, I will present a review of relevant literature in the area of standards in general and standards within the context of Information Systems studies. The first subsection is used to elaborate on the various types of standards, practical benefits, challenges, and the economic perspective in the studies of standardization. In subsection two, concepts from institutional theory are discussed. At last, the literature is summarized in an integrated framework, which is used to guide the syntheses (chapter 6) and contribution (chapter 7) of the thesis.

2.1 Standards and standardization: overview and classifications

I conceptualize standardization to be the result of four analytically distinct but interrelated processes involving standard formation, adoption, diffusion and use (Botzem & Dobush, 2012; Fomin, Keil & Lyytinen, 2003). Standardization may fail at the various stages, suggesting difference between antecedents or mechanisms of standard deployment from the driver of standardization (Bala & Venkatesh, 2007).

Broadly, standards are classified as technical and non-technical. Non-technical standards refer to the metadata and procedural standards that are discussed in the previous chapter. Metadata is data about data or information about information. Describing objects with metadata facilitates interoperability of information systems despite differences in hardware, software, data structure and interfaces (NISO, 2004) using a technical specification. In addition to this broad classification, standards are classified in various ways based on the standard formation process, the nature of the standard, services the standard is intended to provide, and if it is formed anticipating the future or the current use.

2.1.1 De jure versus de facto standards

Broadly, standards are recognized as *de jure* or *de facto* based on the standardization processes they follow (David & Greenstein, 1990). De jure standards are developed and endorsed by an accredited standard organization following detailed procedures and specifications that need to be strictly adhered to. They normally follow a set process of approval by authoritative national and international bodies (Backhouse, Hsu, & Silva, 2006). An example of a de jure standard is ASCII-American Standard Code for Information Interchange and the various ISO standards. The diffusion of such standards is facilitated by the use of rules and regulations. De facto standards, on the other hand, are not enforced by standard organizations. However, they are widely used by industries. Their diffusion is mainly mediated by market pressure. For example, QWERTY keyboard and Microsoft Windows are de facto standards that are not enforced by law, rules, or regulations but are widely used through network effects and increasing returns (David, 1985). While de facto standards can be developed by one or few organizations, de jure standards are developed by many

organizations making consensus building at the core of their development process. The following table summarizes originators, main diffusion mechanisms, enforcement and nature of de jure and de facto standards.

Type	Originator	Main adoption and diffusion mechanisms	Enforcement	Nature
De jure	Standard organizations	Market and Institutional pressure	Mandatory	Propriety/Open
De facto	Interest groups or industries		Voluntary	Open/proprietary

Table 2-1: De jure and de facto standardization processes

2.1.2 Open versus closed standards

Technical standards are a set of specifications or rules consisting of data formats, document styles and techniques that govern the communication between hardware and software produced by different vendors (Chen & Forman, 2006). Such standards can be *open* or *closed (proprietary)* based on their cost and availability to the general public (ibid.; West et al., 2007). The specifications of open standards are available to the public so that anyone can use them. The specification of closed standards is not available to the public. Open source software is the ultimate form of open standards (West et al., 2007). In addition to being cheap, open standards are also meant to maximize creativity by making people contribute to the development of such software. The often-cited successfully evolving infrastructure using open standards is the Internet. These standards allow interoperability among the million independent computers in the world (Hanseth & Bygstad, 2015). Due to its open nature, the Internet involves multiple standards such as protocol standards (e.g., TCP/IP), and standard web programming languages like HTML. These are layered in a way that when a standard stabilizes through time it becomes a platform for other standards to be formed on top of it (ibid.). Open system may lower the entry for complementary producers by granting total compatibility access to proprietary software (Lacocq & Demil, 2006) contributing positively to their emergence and evolution as a standard.

Among the down sides of some proprietary standards is the presence of switching costs (the cost of changing vendors) by making products incompatible horizontally and vertically in the production line. This makes open standards preferable as they facilitate compatibility and interoperability and remove switching costs (West, 2007). However, in some cases, the openness cannot guarantee the promised removal of switching costs as vendors tended to add proprietary enhancement to the standard on the grounds of providing better service (Chen & Forman, 2006). From the case study of switching costs of routers and switches, Chen and Forman (2006) questioned if the use of regulatory measures should be enforced to protect such enhancement of open standards to reap the full benefits of the open nature.

2.1.3 Types of standards by service

Timmermans and Berg (2010) specify four types of standards in the context of medical protocols for treatment and actions. These types are based on the service the standards provide to their adopters. These are *design*, *terminological*, *performance*, and *procedural*. Design standards set structural specifications. For example, the syntax standard SDMX-HD (statistical data and metadata eXchange) is a WHO implementation of the ISO SDMX-HD standard that provides structural specification to enable data exchange between systems (Braa & Sahay, 2012). Terminological or semantic standards ensure uniform meanings across organizations. For example, the implementation of NANDA—a coding list specific to nursing diagnosis—is one of the global terminological standards for health (Meum, Ellingsen, Monteiro, Wangensteen, & Igesund, 2013). This includes the definition of metadata such as data elements, organizational units and indicators. Procedural standards specify processes for performing a given task. These are the most contested and difficult to achieve, as they require change in individuals' work culture (Timmermans & Berg, 2010). Empirical examples of such standards are given in sub-section 2.2. Lastly, performance standards focus not as much on how to do things but on the result of the deed. They are used as a point of reference for comparing results. In health care, there is a usual practice of setting annual performance targets for service delivery against which actual performance is measured. These kinds of standards help to improve service delivery and are thought to increase accountability. The degree of challenges faced during the formation, diffusion and institutionalization of standards is contingent upon the type of standard.

2.1.4 Anticipatory versus non-anticipatory standards

Taking the time to standardize into consideration, standards are also classified as *anticipatory* (ex ante) or *non-anticipatory* (ex post) standards (Bousquet et al., 2011). Anticipatory standards define the future capabilities of products and services in contrast to standardizing the existing practices or capabilities as done in non-anticipatory standards (ibid., p.18). Hanseth and Bygstad, (2015) compared anticipatory standards with two other empirically generated standardization strategies—integrated solutions and flexible generification. They conclude anticipatory standards to hinder service innovation, while flexible generification (i.e., work process and actual use determined standards) promotes service innovation thereby facilitating the evolution of the standard. Gizaw (2014) discusses open generification as a design strategy for making IT solutions evolve through time and space while providing possibilities to promote service innovation in places where the standard is being adopted. A brief discussion of such design strategy is given at the end of Chapter 3, together with the HISP standardization activities. These two strategies—*flexible and open generification*—can be seen as a way to resolve the criticisms towards standards as hindrance for innovation as pointed out by Timmermans and Berg (2010) and as a strategy for standard emergence and evolution.

Within the aforementioned classifications, the standards this thesis addresses fall into the category of both technical and non-technical and they follow largely the classification of Timmermans and Berg (2010). The data and procedures are often developed nationally (via MOH) in collaboration with partner organizations and their implementations are mandatory and they can be considered as *de jure*. However, if the process follows a bottom up approach, its implementation can be voluntary through continuous process of enrolling stakeholders and adapting it to the use context. The technical standard refers to DHIS as an emerging *de facto* standard for monitoring and evaluation. When a technology is a dominant design, it is considered as a standard (Narayanan & Chen, 2012). The standardization strategy DHIS is following, inferring from literature, can be called open and flexible generification. In addition, the open feature of DHIS, I argue, can contribute to its evolution into making it the HIS standard. It is worth mentioning here the fact that these classifications are analytical dimensions to increase our understanding about standards and standardization.

2.2 The dilemma over universal standards and individual particularities

Universal (global) standard, here, refers to standards for all functions and all intended users with no redundancy and inconsistency (Hanseth & Braa, 2000). There is a good amount of IS literature that has reported the dilemma over the need for universal standards and the peculiarity of local practices. Some concluded that universal standards are illusions and that there is only local universality (*ibid.*). Others are critical to the very idea of cleaning up all inconsistencies and redundancies, arguing that it is perhaps seeking unwanted purification that can be counterproductive (Monteiro, 2003). They imply universal standards are something contrary to the inherent particularities of individuals and the diversity of the world we are living in.

Universal standards are considered especially relevant for transnational organizations that operate in various countries. Such standards are employed to coordinate and organize geographically dispersed work, which in turn enable the exercise of control over distance by reducing complexity and risk (Rolland & Monteiro, 2002). Organizations “fail to realize the benefits of such digitization because of lack of integrated and coordinated inter organizational business processes” (Bala & Venkatesh, 2007, p, 340). In other cases, universal standards are used as a means of quality assurance, which in turn provide firms credibility with customers. The ISO standards are an example of the latter. As discussed in the previous chapter there is also a need for a global standard for comparing outcomes of interventions in various settings. An example of this could be the use of International Classification of Diseases by WHO (Bowker & Star, 1999). In all cases, implementation of global standards has been contested by the local context that is “constituted by locally produced and institutionalized practices and the existing infrastructural resources (Rolland & Monteiro, 2002, p.88). Therefore, global standards—data, procedure or tools—need to be adapted to the local context to reap their full implementation benefits.

For example, Sandholtz (2012) discusses how the same ISO 9000 standard was adopted in one organization's two engineering divisions to improve management and service quality. Division one abandoned the use of the ISO standards after getting the certification. The engineers in the division considered the standard constrained their creativity and limited their freedom to exercise their professional duty. They argued engineering work was not fully predictable and that they had to improvise to come up with the best solutions to accomplish their daily tasks. In this way, the standard quickly became decoupled from the division work for a reason that the standard would make the engineers decouple from their professional duty by giving them a recipe of work processes. In the second division, the need for such type of standards came from business necessity not as a matter enforced by the management as it was in division one. After an earlier attempt to implement an ISO standard in this division failed, they developed a bottom up approach using selected engineers in the section, which finally led to an establishment of an engineering work procedure standard. The work procedure they established was, although not entirely the same, similar to the ISO standard. The process helped to create future organizational readiness in adopting ISO, which converged the viewpoint of the engineers and the management and facilitated the adoption of the ISO standard not for legitimacy but for efficiency. This case highlights how an external standard was confronted by norms and practices of existing community of practice.

In a similar study, Meum, et al. (2013) analyzed how global terminological standards are inevitably bound with local practices through a case study of the implementation of NANDA in a Norwegian hospital. NANDA is a standard classification of diseases, which is developed by American Association of Nurses for nursing diagnosis. A nursing electronic module based on NANDA was implemented in the hospital and its use was mandatory. However, the revisit of the implementation after a year showed that the nurses could not find appropriate diagnosis and interventions from the classification. Therefore, the mandatory use was changed to voluntary allowing the nurses to enter their own local terms. Consequently, the use of NANDA decreased. Mapping of the local terminology with NANDA after three years, however, revealed that there was a high degree of similarity between NANDA and local diagnosis implying the new terminologies were shaped by the previous NANDA use by the nurses. The authors suggested the need for flexibility to accommodate local innovation and domain specific knowledge through the use of social tagging (folksonomies) that can be a means to bridge the gap between the local and the global.

Drawing on material from a Scandinavian-based and globally operating (in more than 100 countries) Maritime Classification Company (MCC), Rolland and Monteiro (2002) emphasize the need to continuously negotiate requirements with local offices to develop a global standard. They call the process "reflexive design process". It means always remaining open to negotiate local needs if the standard will not be abandoned for not addressing these needs. In their case, the distributed offices used the global standard. However, deviation from the standard happened due to the necessity of reporting context specific special cases. The authors viewed standardization as an ongoing negotiation and system redesign process as a solution to strike a balance between the local and global information systems. Given that view, the authors suggested certain fragmentation and

uncertainties at the local level should not be considered as a total failure for the global standard. Rather, it should be looked at as a mutual transformation of the local context and the global information systems taking elements of the information infrastructure as a point of analysis.

The above cases and other related works pointed out two major issues when it comes to forming, diffusing and putting in use standards. The first issue is the need for a bottom up and participatory standardization processes involving not only standard users but also third parties (cf. Sandholtz, 2012; Braa & Hedberg, 2002; Slager, et al., 2012; Aanestad & Jensen, 2011). In the story of Sandholtz (2012), the division two work practices were tightly coupled with the standard and the engineers accepted the global standard without resistance after building their own standardized procedure. This is because “When standards are “homegrown,” they assimilate the group’s processes, rather than the group assimilating to standard processes” (Sandholtz, 2012, p. 674). The second issue is the recognition of standardization as a continuous non-linear process, which is permanently supported by micro-level activities (Slager, et al., 2012). In short, standardization is an iterative process, which is performed in close collaboration with practice (Meum et al., 2013) through mutual adaptation.

In another case, Backhouse, et al. (2006) recognize the role of power and politics and the exogenous institutional forces to the creation and institutionalization of standards, which emphasizes the need for a top-down approach. The literature seems to swing between bottom-up or top-down approach for successful standardization. I contribute to this literature by identifying the different aspects of HIS standardization recommending a bottom-up or top-down approach to their accomplishments. In either case, standardization requires mutual adaptation. On one hand, the standard transforms the context and on the other hand the standards need to accommodate the contextual requirements.

2.3 Adapting standards

Whether a standard is global or national, de facto or de jure, there is inherent need to mold and mesh toward the local context, and the local context needs to be transformed to make use of the standard (Rolland & Monteiro, 2002). The local context is composed of the various institutions and infrastructural resources that hinder or enable standardization processes. Adaptation requires simplifying the complex standardization process into various loosely coupled modules (Hanseth & Lyytinen, 2010). One way of modularizing the technological standards is identifying the sub standards, like the technology itself, and what it contains for facilitating data interchange among the sub-units and how the work flows among the sub-units. This is important as not all types of standards are accepted and diffused equally and that incremental change to each of them facilitates the continuous process through learning from previous experiences (ibid.). This also requires modularization of the institutional context in which the standard is needed in order to be adapted.

Adaptability requires flexibility of the standards to accommodate idiosyncratic local practices and infrastructural and institutional context differences. For example, uneven infrastructural development within and across developing countries was identified as a main hindrance of HIS standardization in developing countries (Braa et al., 2007b). Accordingly, the authors suggest a flexible standard strategy for addressing the infrastructural contrast. This means focusing more on the data than the container of data; meaning using DHIS where there are computers/electricity and in places with poor infrastructure using paper formats. These two are then connected with gateways of metadata standards. When this becomes stabilized and the infrastructure problem is resolved, the electronic tool can be expanded to the geographical areas with poor infrastructure.

Standards need to be flexible in both use and change if they have to serve the dynamic and hierarchical health care context (Hanseth & Monteiro, 1998). The use flexibility refers to the ability to use the standard for different tasks. Change flexibility refers to accommodating changes across time, for example, the ability of accommodating the emergence of new diseases. Data standards need to also be flexible to accommodate varying needs within the ingrained hierarchical structure of health organizations. For example, a data element that is very relevant for a district manager may not be useful for the regional manager. Therefore, standards should allow the district data manager to add an own data element as long as there is adherence to the national and regional data standards. This flexibility is conceptualized as *hierarchy of standards* (Braa & Hedberg, 2002), and it enables inter and intra organizational standardization of business processes (Bala and Venkatesh, 2007). However, in practice, there is little attention to the hierarchy of information needs due to the inherent weak data-indicator linkage that characterizes the HIS of developing countries (Latifov & Sahay, 2012).

Haack, et al. (2012) analyze how narration as standardization strategy contributes to create organizational commitment that can facilitate adaptation of the standard. The author explains the influence of pre-standard adoption story telling on the adoption and institutionalization of ISO standards. Above all, getting all stakeholders on board in an organizational field is a necessary step towards standardization. Whether a standard formation process is inclusive or exclusive determines its adoption and diffusion (Botzem & Dobush, 2012). An inclusive standard formation is one which is open for users input and collaboration in case of de jure standards. FOSS follows an inclusive standard formation that arguably may facilitate standard diffusion. The key to successful standardization is, then, managing the diversity of participants (van den Ende, van de Kaa., den Uijl, & de Vries, 2012) and the logics they use to justify their acceptance and/or rejection of a standard. A bottom-up project started with a good intention of involving a number of participants may change to top-down leaving room only for a few participants (Hanseth et al., 2006). This is due to the unmanageable size of participants and difficulty in finding common ground (ibid.). This indicates participation should also be conducted in a modular fashion. Braa and Sahay (2012) gave an empirical example of this with respect to the national dataset standardization processes. This example and other approaches from HISP are discussed at the end of this chapter.

In summary, the current literature (as presented in Chapters 1&2) on standards in information systems has looked at the various standard types and the dilemma over universal standard and local particularities. Various approaches have been suggested on how to make standards adaptable to the context. The emergence and evolution of standards have been theorized within an economic perspective as discussed as follows.

2.4 Economic perspective on standards

The economics of standards is concerned with analyzing how network affects/network externalities of a certain product, technology, or service drive the emergence of standards (Narayanan & Chen, 2012). It is specifically concerned with analyzing how network externalities influence the adoption and diffusion of products through increasing returns and path dependency, which may ultimately create lock-in effect to the adopters (Saloner & Farrel, 1985; Arthur, 1985, Hanseth, 2000). In this perspective, market acceptance is an integral part of a dominant design, which is denoted as a standard that is recognized post hoc (Narayanan & Chen, 2012). The size of the firm can play an advantage role to the diffusion of standards. Larger firms have market advantage as they implement different strategies like incentive or bias, delay or sabotage to erode, extend and preserve monopoly power (Saloner & Farrel, 1985).

Network externalities or network effects are effects of a user on the value of the product to other users. This means “a product may simply be more valuable to each buyer; the more others have the product or service” (Saloner & Farrel, 1985, p. 7). An example of this could be the English Language or a telephone line. Therefore, the more the product is adopted, the more it becomes attractive to other users creating a large user base having a determining role for buying the product rather than the nature of the product. Moreover, the more a particular “product is adopted, the more experience is gained with them, and the more they are improved” Arthur (1989, p. 116). The more the product is improved, the more it may become appealing to potential adopters due to the increasing return for adopters. In addition, the large installed base attracts complementary products making it cumulatively attractive to others; gaining credibility among the potential adopters and further increasing the size of the installed base (Cottrell, 1994; Hanseth, 2000, p. 62). Figure 2-1 depicts the self-reinforcing nature of standard adoption and diffusion.



Figure 2-1: Conceptual model for the economics of standards (Source: Grindley, 1995)

An example of this could be the DHIS software. The increase in the installed base means that the software is increasing in quality as various adopters are testing and using it. This, in turn, increases the credibility of the software making it further expand in user base and added functionality. Moreover, more complementary services are being added to the core module, which attracts more users.

A key feature that determines the scope of the network is if the products of two or more companies can be used together. In terms of software products, interoperability contributes to increase in network size and positive network effect. While the value of the network to standard adoption has been clear, the main concern for benefiting from network externality is how to get early adopters that give momentum for further adoption (Hanseth & Aanestad, 2003). Therefore, addressing “bootstrapping” problems by designing software for usefulness that attracts potential adopters may give the required momentum. Historical events or “chances” at an early stage leads to path dependency that can have detrimental effects in the diffusion of the product.

This happens due to first, early advantage gained and the tendency of those advantages to be reproduced further (Arthur, 1989). Second, early decisions concerning design will influence future design decisions (Hanseth, 2000). In case of early design decision, for example, if a technology is designed in a flexible way to be compatible with earlier versions, other complementary products and new requirements in the organization, it may have a tendency to continue as a standard (ibid.).

After a certain point, network congestion or saturation may happen making the value of additional adoption counterproductive to the supplier unless the supplier side is adapting to the large network size. From the adopters’ side, a large installed base can create a lock-in situation, where there is a high switching cost in the case of choosing another competing product. Contractual agreements, brand specific training and habit of using old technologies are reasons that lead to lock-in effects (Shapiro & Varian, 1999 cited in Hanseth, 2000). A flexible standard, which is meant to accommodate change over time may affect a lock-in situation making the emergence of different

competing technology harder. To get out of lock in, an evolutionary strategy of backward compatibility and a revolutionary strategy of wiping the slate clean and coming up with best products is recommended (Hanseth, 2000). This combination of radical and evolutionary strategy is similar to what institutional scholars recommend for changing institutionalized practices and legacy information systems. However, while the economic perspective emphasizes the network and the large installed base as factors for successful evolution of standards, institutional perspective, as discussed below, is more concerned with analyzing the reason behind standardization failure/success at various stages of the standardization processes. As it is presented in Chapter 5 and Chapter 6, economic mechanisms of standardization are not very prominent in explaining what happens in the public sector. Therefore, while looking at the DHIS (the tool) diffusion in the public sectors within the economic perspective, I will use institutional perspective to explain the underneath standardization process (data and procedure) in the three countries. In this way, I will try to highlight how the two perspectives complement each other in understanding HIS standardization.

In the next subsection, I will present main concepts from institutional theory and how those have been applied in IS studies.

2.5 Concepts drawn upon institutional theory

In this subsection, I will introduce the institutional concepts I used in the papers and in discussing the integrated findings of the thesis in the later chapters. I will begin by providing a brief background regarding neo institutionalism that positions this study within the economics and sociological neo institutionalism literature. After that, other institutional concepts are discussed. I will use these concepts to provide an institutional perspective of standardization in Chapter 7.

2.5.1 Background

This study draws from the new or neo institutionalism (Scott, 2001; Powell & DiMaggio, 1991). New institutionalism does not constitute a unified body of thought but can be seen to be comprised of at least three distinct schools of thought that have evolved over time (Hall & Taylor, 1998). These are: historical institutionalism, rational choice institutionalism and sociological institutionalism. The basic idea of rational choice theory is that patterns of behavior will develop in a society as a result of individual choices comparing costs and benefits of different actions to maximize their benefits and minimize their costs (ibid.). Historical institutionalism discusses the “path dependence” nature of institutions in a sense that choices formed when institutions are formed have a constraining or enabling effect into the future. These are within the institutional economics domain and similar to the economic perspective of standards I discussed above. On the other hand, sociological institutionalism emphasizes norms and values in explaining the existence and persistence of institutions (Soltan et al., 1998). While the above distinctions of the three schools is analytically relevant to understand new institutionalism, in practice, all three are useful

to understand the patterns of behavior exhibited in society broadly and at the organizational level specifically.

2.5.2 Definition(s)

Different scholars have variously defined the term *institution*. While some use the term institutions to mean organizations, others refer to the rule-like influences that shape human interactions. The economics historian Douglass North gives the most precise and frequently used definition of the term. *Institutions*, as defined by North (1990) are humanly devised rules in a society that shape human interactions –“rules of the game”. These include a combination of formal rules and informal constraints. While formal rules contain political rules, economic rules, and contracts, informal rules include taboos, customs, traditions, perceptions and myths (Jepperson, 1991). Powell and DiMaggio (1991) expand this definition in the context of sociology of organizational studies to include the unconscious activities of human beings, by saying “while institutions are certainly the result of human activity, they are not necessarily the products of conscious design” (p.8). They can be governed by past experiences, by perceptions and are shaped by the field in which the organization exists - *organizational field*. There is duality in the nature of institutions-institutions are made using other institutions. Scott (2001), recognizing the multiplicity of definitions, gives a broader reconciling definition as: “Institutions are multifaceted, durable, social structures made up of symbolic elements, social activities, and material resources” (p.49). He further describes institutions to be composed of regulative, normative and cultural-cognitive pillars or elements that are discussed below.

2.5.3 Institutional pillars/Elements of Institutions

Here, I will discuss the three institutional pillars and their enforcement mechanisms.

Regulative institutions

Regulative institutions are those institutions that constrain and regularize behavior. They give importance to explicit regulatory processes such as rule setting, monitoring and sanctioning activities. North (1990) views them as formal institutions as they are explicitly stated and there is a written point of reference in case of disagreement. The primary mechanism of control is coercion or sanction and the expected response to regulative institutions is conformity (Scott, 2001). Backhouse, et al. (2006) argue “even though actors are key to the generation and adoption of standards in general, institutional factors, such as regulations and legislation, also play a fundamental role” (p. 415). Regulative institutions contribute to positive standardization outcomes making them evolve towards regulatory positions. However, it is of vital importance to notice that it is rather the interplay of these three elements over time that brings about the required changes in the institutional environment (Currie & Guah, 2007). The indicators for regulative institutions, as described by Scott are rules, laws and sanctions, which are used as an instrument for implementing

and sustaining a technological solution or other practices. Standards with a coercive mechanism are seen as “soft law” (Sandholtz, 2012). While ““soft” implies the voluntary aspect of standards, “law” implies that non-compliance carries consequences” (ibid., p. 658).

Normative institutions

As the name indicates, the chief concern of normative institutions is upholding values and norms. Norms may not have an identifiable author nor are explicitly stated, but they are voluntarily adopted (Busch, 2011). At society level, norms appear from nowhere as part of the “collective conscience” (ibid.). For example, while values are related to the principles that are constructed to guide a certain behavior, norms specify how things should be defined to achieve goals and objectives. At organizational level, professional associations or other types of institutions set the norm for the collective. While the mechanisms for adoption and diffusion for such systems is normative, the indicators are certifications and accreditation. The underlying basis of legitimacy is moral governance and the basis for compliance is social obligation. The logic for normative institutions as stated by Scott (2001) is appropriateness. Related to this, Lyytinen and Damsgaard (2001) studied the role that intermediary institutions like trade associations have in knowledge building, deployment and standard setting for the adoption and diffusion of EDI technology in three countries –Hong Kong, Denmark and Finland. “Professionals, particularly physicians, but also others, have constructed normative frameworks that provide much of the foundation for the stable conduct of practice” (Scott, et al., 2000, p.21). These normative institutions create appropriateness for their actions. Normative pressures are more important for adoption of standards in an organization that has greater power over their partner organization (Bala & Venkatesh, 2007).

Cultural-cognitive institutions

The cultural-cognitive institutions emphasize the cognitive dimension of human existence that constitutes the nature of social reality and the frame through which meaning is constructed. While cognitive-cultural is about the construction of common meanings embedded in social routines, the normative institution gives relevance to social obligation and binding expectations, specified by standards or industry policies (Hsu, Lin, & Wang, 2015). The diffusion mechanism of cultural cognitive institutions is mimetic. Managers in organizations mimic their successful peers as response to uncertainties (Bala & Venkatesh, 2007). The cultural aspect of individuals in the organization, such as their culture of information use and their perception towards a technological solution, is the concern of this category. In addition to the intermediary institutions, Lyytinen and Damsgaard (2001) discuss how the consensus-oriented culture of Finland facilitated the adoption of EDI. All three institutional pressures are equally important in the adoption of standards where there is no hierarchical relationship (Bala & Venkatesh, 2007).

In describing how Scott's typology of institutions can be useful to understand health information system strengthening initiatives, I discuss an example from Braa and Hedberg (2002). The authors show how ongoing efforts by the HISP initiative in South Africa helped to enhance the culture of local use of information, which subsequently contributed to the creation of a directorate of health information within the government structure. This formal organizational structure then helped to create regulatory institutions to promote the local use of information by requiring through regulation, for example, that districts give quarterly feedback to the clinics on their past performance. This organizational structure and associated culture thus helped to strengthen the cognitive frames of meaning of field staff about the importance of feedback on information. These cognitive and regulatory practices further contributed to the creation of normative institutions where organizationally, moral sanctions were created for example for the non-use of information. Ethiopia, recently, is going in this direction by trying to build a separate structure that aims to promote the value of information and institute an improved information-use culture, which are necessary steps in HIS improvement.

2.5.4 Institutional change

Although institutions connote stability by definition, they are also subject to change process, both incremental and discontinuous (Scott, 2001). Jepperson (1991) identifies four major types of institutional change processes: institutional formation, institutional development, deinstitutionalization, and re-institutionalization. Institutional formation is an exit from social disorder or from disorder to order. Institutional development represents institutional continuation rather than exit. Deinstitutionalization represents an exit from institutionalization or from disorder to order. Deinstitutionalization *"takes place when established meanings and action in an organization are discredited, either as a result of competing meanings and actions or because they are seen as failing to contribute to the institutional existence"* (Avgerou, 2002, p.37). Further, Oliver (1992) describes deinstitutionalization as follows:

"the process by which the legitimacy of an established or institutionalized organizational practice erodes or discontinues. Specifically, deinstitutionalization refers to the delegitimation of an established organizational practice or procedure as a result of organizational challenges to or the failure of organizations to reproduce previously legitimated or taken-for-granted organizational actions" (p. 564)

In simple terms, deinstitutionalization is *"a process by which institutions weaken and disappear"* (Scott, 2001, p.). Oliver (1992) points out three main factors that contribute to deinstitutionalization: political, functional and social. The political pressure (e.g., performance, competitiveness and innovation) refers to change processes of organizational activities as a result of political response to performance problems or increase external pressure to remain competitive and innovative (p. 570). Functional pressure refers to changes to the *"perceived utility or technical instrumentality of (existing) practices"* (p.571). Economic criteria of effectiveness and efficiency

are used to reassess the validity of such embedded practices (ibid.) and rationalize the required change process. Social pressures include historical discontinuities of organizations (e.g., mergers, joint ventures, etc.) that cause change in an organizations' technical and non-technical systems.

While it is agreeable that the aforementioned pressures influence technology innovation, adoption, assimilation and its legitimacy, there is also a technological pressure that fuels institutional change process. Technology by itself contributes to its own uptake through the power of network externality. This is to mean that the value and diffusion of the technological solution is dependent on other factors than the real value it is designed for. This implies that a technology, which is adopted by others, is more attractive for new adopters; creating an environment for being an emerging standard. In this process, the technology becomes a de facto standard, through self-reinforcing mechanisms (Hanseth & Monterio, 1998). In this line of argument, a technology, which has become a de-facto standard, exerts a technological pressure for its adoption. Taking economic perspectives, IS studies have shown how the technology itself sets the conditions for its adoption. Technological pressure, as other deinstitutionalization pressures mentioned by Oliver (1992) and DiMaggio and Powell (1991), could also contribute to the deinstitutionalization of persistent, old and dysfunctional legacy systems that hinder organization from achieving their organizational goals.

The last type of institutional change is re-institutionalization, which represents an exit from one institutionalization and entry into another institutional form, organized around different principles or rules. In this research, I take the two major steps of institutional change, which are *de-institutionalization and re-institutionalization* to understand institutional change in organizations.

Organizational change often occurs as the result of institutional change/institutional pressures that make organizations more similar without necessarily making them more efficient (Powell & DiMaggio, 1991) through a process called Isomorphism. Isomorphism is an explanation of why so many businesses end up having similar organizational structures despite the fact that they have evolved in different trajectories. DiMaggio and Powell (1991) conclude that the net effect of institutional pressures is to increase the homogeneity of organizational structures in an institutional environment. They write that firms will adopt similar structures as a result of three types of pressures: 1) Coercive pressure that comes from legal or regulatory institutions, 2) Mimetic pressures that happen when firms copy other successful firms during periods of high uncertainty. Finally, normative pressures to homogeneity come from similar attitudes and approaches of professional groups and associations brought into the firm through hiring practices. These classifications are consistent with Scott's (2001) institutional pillars, although Scott did not use them to explain homogeneity but to give analytical framework to understand the role of institutions in shaping society. Another concept related to institutional change is the role individuals and organizations play in bringing about the required change. This is conceptualized as an institutional entrepreneur in the institutional theory literature.

North (1990) similar to Scott (2001) describes institutional change to take place in both an incremental and discontinuous manner. Incremental change processes are important in situations where historical and social embeddedness of informal constraints are dominant. He writes: *“Although formal rules may change overnight as a result of political or judicial decisions, informal constraints embodied in customs, traditions and codes of conduct are much more impervious to deliberate policies”* (North, 1990, p.83). Drawing upon North’s arguments, Piotti, et al. (2006) recommend the overlap of formal rules and informal constraints to positively contribute to change institutions. Discussing the unsuccessful attempts of health sector reform processes in developing countries, Piotti, et al. (2006) identified that even though formal rules are established (e.g., strategy plans), the informal constraints (e.g., poor value for information) at the lower levels hinder the rules to be practiced. Therefore, they concluded that in order to bring about organizational change, there is a need to enhance the overlap of the formal rules and informal constraints. Another aspect, which needs to be considered as relevant for institutional change, is institutional logic.

2.5.4.1 Institutional logic

Institutional logics are “organizing principles, which are available to organizations and individuals to elaborate” (Friedland & Alford, 1991, p. 248). They are manifested as the “cognitive map” or the belief system of individuals in an organizational field to guide and give meaning to their activities (Currie & Guah, 2007). These logics can arise as a result of sanction, appropriateness or personal view; therefore, they are the result of regulative, normative and cultural-cognitive institutions. Contradictions that arise from competing logics can help to bring important issues to the field and create discourse and debate that can spur change processes. In practice, there exist multiple institutional logics emanating from diversified groups. These logics may contradict each other posing challenges or opportunities to consensus building and harmonization activities in standardization processes specifically and in IT solution adoptions generally. For example, during the introduction of a national program for information technology in the UK, the National Health Service was found to be constituted and challenged by the past and present institutional logic of stakeholders that fuel and inhibit changes in the governance systems and working practices of the health care practitioners (ibid.). Similarly, Hayes and Rajao (2011) pointed out the need for understanding the different historically emerged multiple institutional logics in the design and implementation of a Geographical Information System (GIS) application in the Brazilian Amazon. The multiple institutional logics in their case study range from the logic of maintaining the sovereignty of the Amazon rainforest to the logic of sustaining human life on earth. In trying to provide strategy regarding how to reconcile varied institutional logics in HIS projects, Asangansi (2012) argues that, rather than focusing on deinstitutionalizing or dissolving existing institutional logic of client organizations, change agents need to employ “changeover” or “dialectical resolutions” in HIS implementation. In his terms, changeover is focusing on one logic without necessarily obliterating the other, and dialectical resolution is appropriating both logics at the same time in the IS adoption and implementation processes. Apart from intentional change processes,

institutional change can also arise as an unanticipated consequence of unintentional, but purposive activities (Hwang & Powell, 2005).

2.5.4.2 Institutional entrepreneurship

The concept of “Institutional entrepreneurship” has emerged to explain how the four types of institutional change, as identified by Jepperson (1991), could take place. This concept emphasizes the view that organizations are not passive recipients of institutional pressure and those individuals and organizations actively employ strategies to bring about institutional changes (Suddaby, 2010). Institutionalists take a broad view of entrepreneurship “focusing not only on the creation of new business organizations, but also on the generation of new organizational models and policies that change the direction and flow of organizational activity” (Hwang & Powell, 2005). The term institutional entrepreneurship thus refers to “the activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones” (Maguire et al., 2004, p. 657). Hence, entrepreneurs are “those actors to whom the responsibility for new or changed institutions is attributed” (Hardy & Maguire, 2008: p. 198) and can be individuals, organizations, networks, associations and social movements. They are considered to have resources, abilities and skills to create and change institutions (ibid.). Social skills are needed to mobilize a collective around a technology for making it a standard (Garud et al., 2002). Institutional entrepreneurship is particularly useful to extend our understanding of how standards emerge, evolve, and decline in industries with differing technology complexity across global settings (Narayanan & Chen, 2012). The governance mechanisms entrepreneurs use to regulate and coordinate activities of a collective are a relevant inquiry in the study of institutional entrepreneurs (Garud et al., 2002). This thesis attempts to examine how the governance mechanism of HISP as loosely attached networks of professionals contributed to the adoption of DHIS and the rejection in Ethiopia.

2.5.4.3 Social capital

The notion of “Social capital” (Cohen & Prusak, 2001) gives a better explanation regarding how an institutional entrepreneur mobilizes resources that provide opportunity to bring about change in a highly institutionalized environment; such as health care. Entrepreneurs and entrepreneurship “are socially situated in which the social environment interplays with the individuals and organizations to drive opportunity discovery, evaluation and exploitation” (Gedajlovic et al., 2013, p. 455).

Social capital, in simple terms, is an investment made to build cooperative activities in organizations that has a potential rate of return (Cohen & Prusak, 2001). The increased appreciation to social relationships in entrepreneurship has made social capital an important theoretical perspective to inform and be informed by entrepreneurship (Gedajlovic et al., 2013).

An institutional entrepreneur, who can draw knowledge and resources from an established network of actors and is part of multiple networks, is highly likely to be in a position to enforce new institutions. This can, for example, be a new way of organizing information systems. The entrepreneur receives legitimacy, possibility, reputation and trust due to the networked relationship. Founding team attributes, individual characteristics of entrepreneurs are antecedents to building social relationships (ibid.). Social capital is a necessary asset in standardization for two basic reasons. First, standards are about cooperation and that requires relations of stakeholders, and second, standardization is resource intensive, requiring the collaboration of various agencies to fill the resource gap (Bala & Venkatesh, 2007). However, the literature is focused on the formal relationship undermining the improvisational skills of institutional entrepreneurs in solving situated problems. This study tries to fill this knowledge gap by taking empirical evidences from India.

Nahapiet and Ghoshal (1998) identify three analytical dimensions of social capital. These are: structural, relational, and cognitive. The structural dimension refers to the overall pattern of connections among actors; who you reach and how. The presence or absence of network ties among or between actors is a key facet of this dimension. When connection and interaction between members of the network gets stronger, other individuals are more likely to become involved. The relational dimension focuses on the particular relations people have, such as mutual respect and friendship, that influence their behavior. Trust and trustworthiness are key facets of this dimension. The cognitive dimension refers to those resources that provide shared representations, interpretations and systems of meaning among parties. According to this description of social capital, institutional entrepreneurs need to be mindful of building network ties recognizing the value of trust, friendship, and mutual learning which enable them to overcome institutional constraints. In addition, the ability of the institutional entrepreneurs to extend the relationship to redeploy the existing relationship assets and routine to other areas influence the assimilation of standards (Bala & Venkatesh, 2007). Relationship extendibility can lead to cost-effective strategy and organizational agility (ibid.) that gives situated problem solving to organizations and allows cross-fertilization of knowledge. Regarding the importance of building social capital in relation to standards, Garud, et al. (2002) write, from their study of making java as a standard by Sun microsystem, as follows:

At the outset, a new standards initiative will have to counter the inertia associated with entrenched standards that enable the functioning of existing technological fields. Additionally, it will encounter resistance from dominant actors in existing technological fields who are threatened by the new standard. As Sun's actions suggest, one way to overcome this initial inertia and resistance is to mobilize a large collective around the new standard. But mobilizing support is not easy. The sponsor has to persuade potential rivals to constrain themselves to a standard that could place them at a competitive disadvantage in the future (p.207).

2.5.4.4 Legitimacy

Institutional perspective is more concerned about legitimacy than efficiency (Orru, Biggart, & Hamilton, 1991) of organizations and their associated practices. Legitimacy is defined as: “...generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs, and definitions” (Suchman, 1995, p.574). Legitimacy “in an institutional perspective is not a commodity to be possessed or exchanged, but it is a condition reflecting perceived consonance with relevant rules and laws, normative support or alignment with cultural-cognitive frameworks” (Scott, 2001, p. 59). However, as Oliver (1992) argued, a decline in performance of organizational practices may lead to deinstitutionalization making efficiency one way of gaining legitimacy. Botzem and Dobusch (2012) identify two types of legitimacy –input and output. In their terms, input legitimacy originates by the involvement of stakeholders in the standardization. On the other hand, output legitimacy is gained based on rational decisions as to the functional necessities of the standard.

Institutional stability stems from the legitimacy imperatives that organizations perpetuate for acquiring or sustaining social approval (David & Bitektine, 2009). For example, certification is used in legitimizing new fields of study (ibid.) in a society. My use of legitimation as a concept is related to how expert beliefs and value judgments are being accepted or rejected in public sectors and how various types of legitimations are needed in bringing institutional change. The following figure summarizes how the various concepts are related to bring about institutional change.

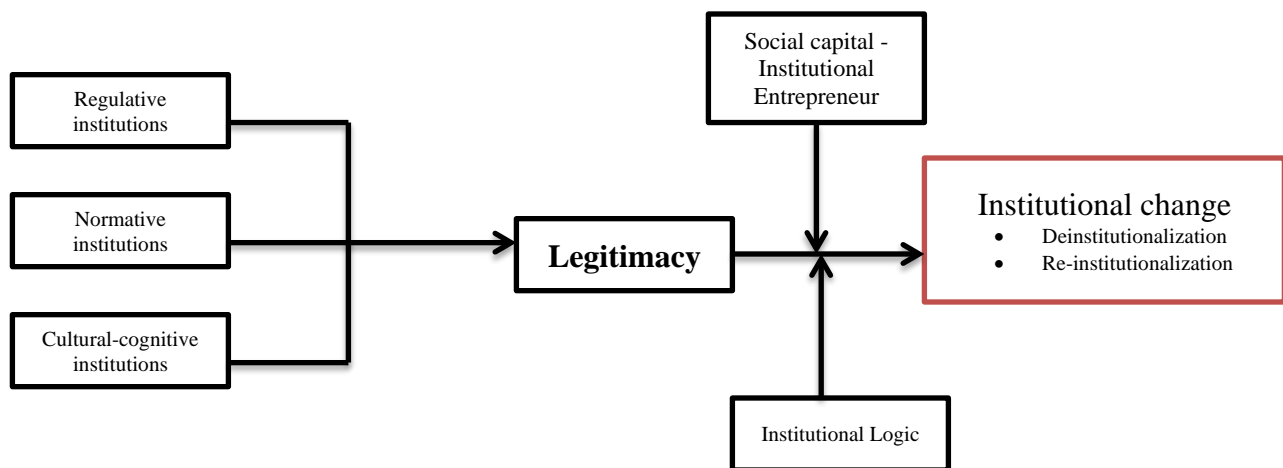


Figure 2-2: Summary of institutional issues that lead to institutional change

2.6 Application of institutional theory in IS/IT

In the context of IS research, an increasing number of studies have adopted an institutional perspective to examine processes of IT development, implementation and use. Orlikowski and Barley (2001) argue why institutional theory is appropriate in IS/IT in the following manner: “*the transformation currently occurring in the nature of work and organizing cannot be understood without considering both the technological changes and the institutional context that are reshaping economic and organizational activities*” (p.1). An institutional perspective to study IS/IT helps researchers to take into account the regulative, normative and cognitive-cultural aspects that shape and are shaped by the processes of IS development, implementation and use.

One of the early studies in the application of institutional theory in IS was carried out by Kling and Iacono (1989), who characterized a Computer Based Information System (CBIS) called PRINTCO as an Institution. The following institutional factors contributed to the failure of the new Material Requirements Planning (MRP) system: 1) the skills, work expectations, and the prior experiences of the staff; 2) the work prioritization scheme that had developed between the computer staff and the end users which made it difficult to introduce new routines; 3) the question of who controlled new development; 4) organizational practices around training users and computer staff; and, 5) prior commitments made to specific groups. Even though the manager of PRINTCO was fired for his alleged inefficiencies, his legacy remained and was difficult to remove, contributing to the failure of the new system. Since then, apart from the study of Avgerou (2002), who characterized a computer system and software development methodology as institutions, others employed it to study the interaction of technology with the external environment. In line with these kinds of studies, Fountain (2004) explains the reciprocal effect between institutions and technology. She writes:

“Institutions and organizations shape the enactment of information technology. Technology in turn may reshape organizations and institutions to better conform to its logic. New information technologies are -made sense of, designed, and used (when they are used)- through the mediation of existing organizational and institutional arrangements with their own internal logics and tendencies. These multiple logics are embedded in operating routines, performance programs, bureaucratic politics, norms, cultural beliefs, and social networks” (p. 12)

The author developed a technology enactment conceptual framework to extend institutional theory to account for IT and emphasize its importance in shaping organizational life. Emphasizing institutional constraints, Fountain’s technology enactment framework shows “how the embeddedness of government actors in cognitive, cultural, social, and institutional structures influences the design, perceptions, and uses of the Internet and related IT” (Fountain, 2004, p. 88). In a similar vein, Avgerou (2002) argues that IT on its own can be considered as an institution that can be seen to account adequately for the processes of transformation of organized activities in a

society. She further discusses how ICT innovation is considered as an institution stating: “*although the merits of particular information systems may be fiercely contested within organizations(...), the wisdom of expanding computer uses in ever more organizational activities is hardly challenged in any organization. ICT applications are taken-for-granted as fixtures of contemporary organizations. Their value has become a 'rational myth'.*” (Avgerou, 2000, p.237-238).

She also argues that system development methodologies—which are taken-for-granted among developers—tend to represent institutionalized myths whose outcomes in particular organizational contexts are not seriously evaluated. Avgerou (2002) is critical about the rational assumption often made by funding agencies and governments that ICTs will bring about socio-economic development in developing countries. Through various practices, such as funding policies, this assumption becomes an institutionalized myth and taken-for-granted, which is promoted by aid agencies despite the abundance of surrounding failure stories.

The theoretical work of Avgerou (2002) and Meyer and Rowan (1991) was drawn upon in the work of Noir and Walsham (2007) in the context of ICT implementation in the Indian health care sector. The authors argue for the mythical and ceremonial roles that “ICT for development” plays in legitimizing development initiatives. For example, the ICT implementation for collecting and reporting health data were carried out only “*...as prescribed by the government, not so much for the technical purpose of the reports (to supply actionable data) but that health facilities could conform, albeit ceremoniously, to institutional government rules*”. Like the study of Kling and Iacono (1989) nearly three decades earlier, Noir and Walsham (2007) also drew upon institutional theory to explain persistence of institutions, emphasizing how ICT is playing a ceremonial role in the health sector of India. However, acknowledging the critical stance of the literature, I turn the argument around and say that the seemingly ceremonial role is a beginning to institutional change. It is a marginal change into how information is stored and processed which arguably contributes to information use in the future.

In summary, in IS studies, institutional theory has been used for analyzing and understanding the impact of institutional pressures on the diffusion of IT innovation, the institutionalization process of software applications and the interaction between IT artifact and existing institutions (DeVaujany, Carton, Mitev, & Romeyer, 2014). However, IS studies are criticized for putting little emphasis on the interplay between the micro and macro institutions (Pishdad, Koronios, Reich, & Geursen, 2014). Mignerat & Rivard (2005) suggest future IS studies should focus on the role of professional associations, technology suppliers and consultants and how they shape the various institutions which in turn enables or inhibits standardization. This study building on previous studies intends to fill this research gap in two ways. First, it explores the normative pressure of HISP, as professional association, on the HIS standardization in developing countries. Second, in paper IV, we analyzed how macro institutions influence micro standard adoption in the health care sector.

The following figure relates the main concepts from institutional and standardization literature. The concepts are used to conceptualize standardization as institutional change. Discussions of the concepts are given in chapter 7 as theoretical contribution of the study.

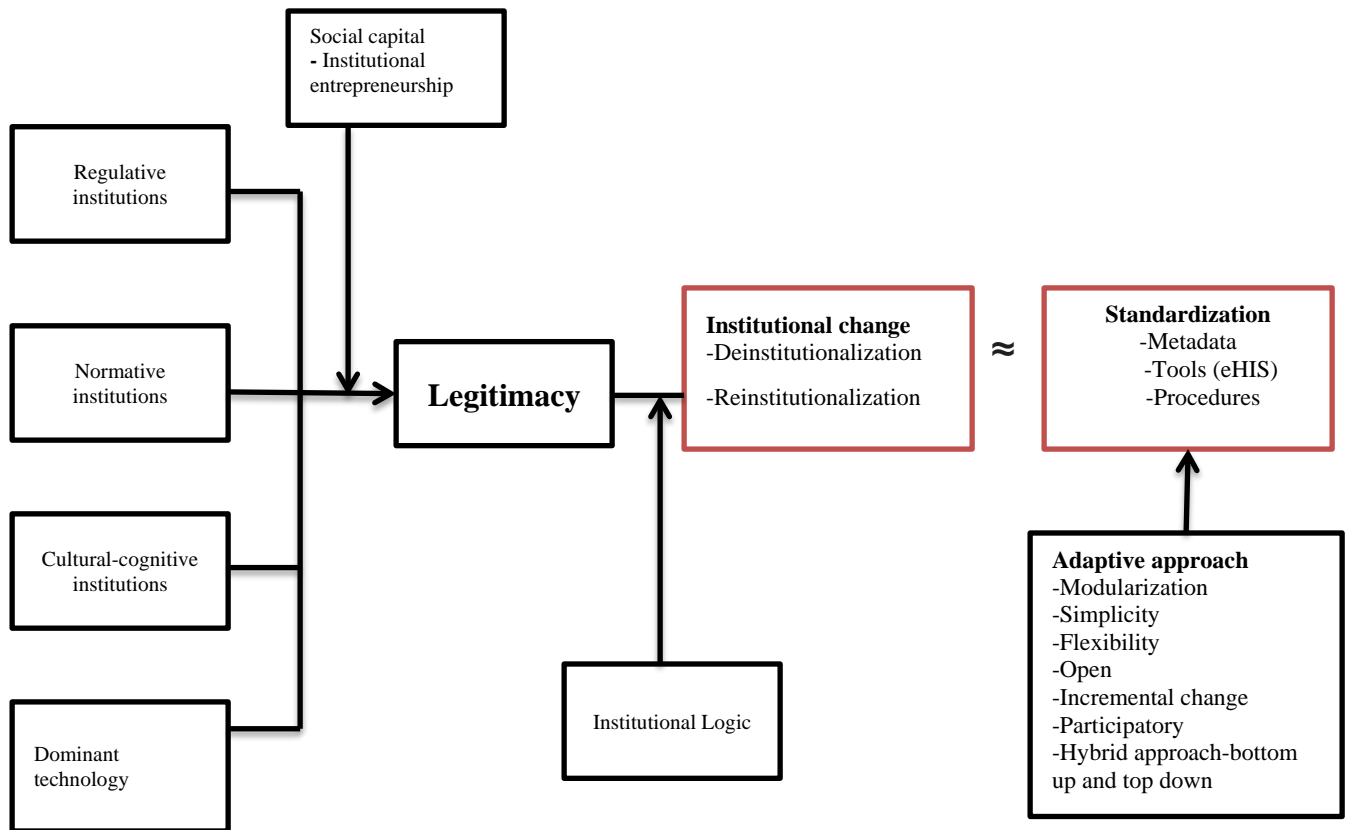


Figure 2-3: Integrated framework for conceptualizing standardization as institutional change

Chapter 3 Research setting

This chapter will present the research setting, where empirical data were collected. As the research was conducted under the framework of the global Health Information Program - HISP, I will start by giving a brief account of the “organizing principles”, historical growth, main research outputs, and the District Health Information Software (DHIS) of the program. The rest of the chapter will be dedicated to providing background information on Ethiopia, India (Gujarat and Kerala) and Tajikistan where the research was conducted.

3.1 The Health Information Systems Program –HISP

HISP, an action-research program, has been going on for the past two decades (1996-present). The early historical account of HISP is documented by Braa and Hedberg (2002) and Braa (1997). According to them, the HISP program was started in South Africa in the early 90’s with the general aim of investigating if a Scandinavian approach to democratic design of information systems may be useful for developing countries and how it may be adopted to such a context (Braa, 1997: p.i). Specifically, the program has been engaged in streamlining and integrating the cumbersome and fragmented health data flow to support local decision-making activities at districts. This fragmentation was a reflection of the social structure of the then Apartheid regime contributing to the HMIS being considered as a social system. Their South African HMIS reforming work involved three key activities. 1) Identifying the information need at the hospital, district, and provincial level. 2) Developing an “Essential Data Set” for Primary Health Care. 3) Developing and prototyping a freely available District Health Information Software (DHIS) for facilitating data exchange across health facilities and administrative units. The process followed a bottom-up approach. These three activities have supplied the base for HISP’s “institutional logic” on how to organize a country’s HMIS. The pilot project in South Africa was funded by the Norwegian Agency for Development and Cooperation-NORAD. After the success of this initial pilot project in South Africa, the program spread to many other countries with the aim of strengthening the respective health information systems.

In Africa, it started its journey to the neighboring Mozambique, and continued to Tanzania and Ethiopia. In other parts of the world, the software has been adopted in India, Tajikistan and other Asian countries. According to the official DHIS website³, currently, around 47 countries and 23 organizations across four continents use the software as a monitoring and evaluation tool at varying levels. In some countries, such as Kenya, Nigeria, Bangladesh, and South Africa, it is a national HIS tool. In other countries, such as India, it is used by regional or state health administrations. Through time, the program managed to create a “network of actions” (Braa, Monteiro, & Sahay, 2004), having capacity building, software development, and implementation as the main tenets of

³ <https://www.dhis2.org>

the network. Accordingly, it has different nodes around the world; University of Oslo being the main coordination and development organ. The network is expanded as a non-profit node in some parts and as profit making organizations in other parts using the same DHIS and giving a wide range of services to public and non-public organizations.

The other nodes with major software development, implementation and customization activities are HISP South Africa, HISP India, HISP Vietnam and HISP West Africa (Braa & Sahay, 2012). The capacity building efforts of HISP are attached with the main PhD and Master program of the University of Oslo and other local universities. In local universities, such as in Mozambique and Ethiopia, HISP collaborated in creating master programs focusing on HIS and information for local use. Extant research output coming out from these programs in the area of data quality and integration emphasized the role of donors in fragmenting and weakening the countries' health information systems (cf. Chilundo, 2004; Kimaro & Nhampossa, 2005; Mosse, 2004; Lungo, 2003).

For example, regarding donor's adverse influences for comprehensive health information systems, Mosse writes as:

“[Donor] influences have contributed to a multiplicity of donor supported information systems, which have implications on the introduction of new initiatives like HISP” (p. 39).

Similarly, Kimaro writes:

“The donor supported vertical programs targeted towards specific diseases have their own parallel reporting systems which contribute to overburden an already busy health staff, and thus undermine overall decentralization efforts” (p. ix).

They also showed the design-reality gap that existed between DHIS and the institutional context in which it is supposed to function (cf. Lungo, 2008; Nhampossa, 2006; Kimaro, 2006). In trying to fill this gap, while most software development work is going on in Oslo, the customization activities are done within the local context by the “intermediary institutions” (Lytinen and Damsgaard, 2001) such as HISP India and HISP Tanzania. The outputs of customization processes have been instrumental for the evolution of the software providing contextual requirements that need to be appropriated in a generic way. In the context of Tanzania, Lungo (2008) recommended the closure of the design reality gaps for the success of an HISP open source initiative. Those gaps were: developer-sponsor gap, global developer-local developer gap and local developer-and local user group gap. The strategies he recommended are political negotiation, FOSS oriented education in the universities, and intensive user training and computer literacy.

The research outputs of HISP also identified poor culture of information and poor quality of data as informal institutional constraints for the full realization of ICT supported health information systems in developing countries (cf. Kimaro, 2006; Braa & Sahay, 2012). One of the reasons for poor data quality in health is the high prevalence of traditional medical practices in Africa, which do not feed in data to the formal MOH HIS (Kanjo, 2012). This leads to incompleteness, which is

one of the criteria for measuring data quality. In relation to data quality, the empirical experience from Tajikistan informs the existence of indicator-data mismatch; meaning either underlying data is unreliable for indicator generation or indicators cannot be calculated by the data (Sahay & Latifov, 2009). These results are despite the fact that the main “institutional logic” of HISP is “information for local action” (Braa, 1997, Braa & Hedberg, 2002; Braa & Sahay, 2012). In fact, it shows how challenging it is to change a deeply institutionalized practice through the introduction of ICT tools. This challenge was recognized in the beginning of HISP’s action research in South Africa and Mongolia. Braa described the difficulty of changing the information systems in these countries in this way:

“a main finding common in the two countries is that the institutional legacy from the old systems, the apartheid and the soviet state respectively, still provided considerable resistance to change and thus represented substantial obstacles to the health sector reform underway in both countries” (Braa, 1997, p.55)

The capacity of users, in developing countries, on health information systems in general and a computer-based system specifically has also been reported to be poor (cf. Kimaro, 2006). To respond to this problem in an organized way, the program has crafted a series of DHIS training programs through the DHIS academies⁴, which are conducted in different languages, countries and trainee levels.

However, the “institutional logic” of HISP seems to be gradually changing by responding to the changing needs, growing user number, and adapting to the local institutional context it is facing. For example, though it started as an action-research project with mainly students doing both the action and the research, it is now has approximately 13 full time employees in the Department of Informatics, University of Oslo, who are engaged in software development, training, and implementation. The logic of serving primary health care has also expanded to covering the needs of donor and other NGOs. The DHIS software is now being used by donor agencies (such as PEPFAR, USAID, PSI) as a principal monitoring and evaluation tool for their work. One can argue the incorporation of donors in the software development as something that potentially culminates their adverse influences on a country’s HIS. In addition, the donors have been providing financial resources, which contributed to sustaining the network through time despite the inertia of the local institutional context. In addition, the initial logic of automating “aggregate data” is now expanded to automate patient-based information through the use of an integral tracker module providing additional layers of complexity regarding how to handle patient data.

⁴ <https://www.dhis2.org/academy>

3.2 The District Health Information Software: An emerging M & E standard

DHIS is application software for collection, validation, analysis, and presentation for both aggregate statistical and patient-level disaggregate data for supporting evidence-based decision-making. Through my action research involvement and looking at the current trend, I see it as an emerging de facto standard for M&E. The software has gone through two major version transitions (i.e., DHIS1 and DHIS 2) since its first implementation in 1997. The DHIS version 1 was initially developed based on the Microsoft Access platform via a series of participatory prototyping methods (Braa & Hedberg, 2002). Even though DHIS1 was based on a proprietary operating system, the application source code was freely distributed allowing further development. It was flexible in a sense that location specific metadata (like data elements, organization units, level of hierarchies, and data collection frequency) could be easily changed without accessing the source code. The version, which was piloted and implemented in South Africa, Mozambique, Tanzania, India, and Ethiopia until 2007 was version 1.3 and 1.4. However, this first version “had limits primarily because of messy database architecture which had grown in a relatively ad hoc manner over time. It could not be scaled easily to other settings as evidenced by the difficulties faced initially in its internationalization. Not being compatible with the web, provided another set of serious constraints to the technology, in how much it could be expanded.” (Braa & Sahay, 2012 P.xiii). The internationalization problems are well documented by the doctoral thesis of Nhampossa (2006). Nhampossa researched the challenges of transferring the South Africa developed software into the Mozambican context given the need to support the Portuguese language, which the technology did not accommodate well. In addition to the technical limitation; version 1.4 could not respond to the institutional context differences among countries. Sæbø and Titlestad (2003), from their experiences in Cuba, discussed the challenges related to the use of Microsoft based software in the Cuba health sector because of the economic embargo imposed by the USA on Cuba.

These limitations of the old version led to the birth of a more generic and scalable DHIS version 2, which is a Free and Open Source Software under the BSD license. This means that instead of paying for a software license, the development cost is distributed among those stakeholders who are involved in the development process (Braa et al., 2014). While technologically very different, both versions have been committed to the principle of use and change flexibility by allowing users to configure the system with their own location-specific data. DHIS version 2 is platform and database independent in a sense that it can be installed in any operating system (e.g., Windows, Linux) that has a Java Runtime Environment (JRE6 or higher). It can also run in any major database systems, such as Oracle, PostgreSQL, that are facilitated by the use of Hibernate database mapping framework. It is web-enabled needing the Internet as an underneath infrastructure for its full utilization. However, given the limited Internet availability in the developing world, the system also allows stand-alone installations where there is no Internet access. In addition, it has an android mobile data collection feature that allows users to collect data

using android tablets and mobile phones. Data in these devices can be stored for around three months not needing continuous Internet connectivity for data collection and reporting. This sort of features makes it an adaptable system with the existing poor electricity infrastructure in developing countries. For example, local communities in Uganda are the early adopters of the mobile application for fast collection of data on maternal and child health (ibid.). Data being collected by various devices, offline installations or any other software other than DHIS, the software effectively facilitates interoperability through the import/export functionality. DHIS 2 has an advanced data visualization module such as GIS, various types of charts, reports, pivot tables and dashboards, which present the collected data in a more meaningful way. The software can be translated into the local language, which is supported by Unicode.

DHIS has a modular software architecture, which supports distributed software development (Staring & Titlestad, 2006; Gizaw, 2014). It is mainly a three-layer modular architecture, which is composed of the core (store), business, and presentation layer (Gizaw, 2014). The store layer contains the Data value, which is described by data element, organizational units, and period. The business layer contains various services DHIS provides; for example, aggregation service for data collation, validation service for data quality, and expression service for indicator definition. The presentation layer enables language translation (ibid.).

However, distributing development work as stipulated in the modular architecture has not been fully materialized. Developers from the developing world were found not to have enough exposure to the advanced open source frameworks DHIS is built on (Braa & Sahay; 2012; Staring & Titlestad, 2006; Lungo, 2008). Moreover, the culture of participating in an open forum did not come smoothly because of language and cultural differences (Staring & Titlestad, 2006). This has led to the core DHIS development work being concentrated in the University of Oslo and to a lesser extent in Vietnam. These phenomena need understanding of how open source software can be adopted in the public sectors of developing countries. The DHIS software does not need only technological environment but it needs a change in the institutional context for its successful uptake. One of the papers included in this thesis is devoted to identifying the institutional mechanisms that facilitate the adoption of FOSS software in Ethiopia and India so that developing countries will also be beneficiaries of the advantages FOSS is providing.

In summary, HISP is an action-research program that is based in the Informatics Department of the University of Oslo. The main aim of HISP is supporting local decision-making processes through the use of free and open source software. It is partnered with national, international and local governmental and non-governmental organizations that are instrumental in providing human and financial resources. The activities of HISP include: development of the DHIS software, securing funding for software development and implementation, capacity building through PhD, Master and DHIS training, coordinating with the intermediary institutions for customization and implementations, and producing research outputs as part of the master and PhD education that

feeds into the HISP action projects. The interaction of HISP with the health organizations in different countries has resulted in different outcomes that can be attributed to the various institutional differences in the country. Next, I will present background information on the three research settings in which this research was conducted.

3.3 Background and existing HIS situation of Ethiopia

Ethiopia is a landlocked country that is found in the East of Africa and mostly known by the mainstream media for recurrent drought, long distance runners, and the current economic and infrastructural development the government is pursuing. It is one of the few countries with no legacy of colonization. The country is in the 13th place in the list of population per country having a population of 94.1 million with a median age of 18 years⁵. Ethiopia is the second most populous country in Africa. According to the national population census of Ethiopia, the population is growing by an average rate of 2.6 % with regional variation ranging from 1.7% in Amhara to 4.1% in Gambella. The country is divided into nine ethnically based regional administrations and two city governments, i.e., Addis Ababa and Dire Dawa. The health administration is structured in a hierarchy of five levels - national, regional, zonal, district, and health facility. In Addis Ababa, there is no zonal administration unit, and, therefore, the region health bureau is made up of four hierarchical levels –national, regional, sub-city and health facility. Politically, Ethiopia is a federal parliamentary republic, where the parliament elects the prime minister. The Ethiopian constitution gives the right to independence up to secession to the ethnically based regions. This means in theory, and translated to the context of this thesis, the regions can choose technological solutions for regional use without needing approval from the national ministry. In practice, such choices are not seen materialized. Ethiopia has a highly bureaucratic system, which is criticized as a hindrance for private business and diffusion of innovation. The prime minister admitted the situation in his recent interview with the allAfrica online newspaper as follows:

We a hundred-year old backward bureaucratic system, starting from the feudal system up to now.(sic) We have been trying for the last 20 years to reform this bureaucracy. It's very difficult to teach an old dog a new trick. So with that difficulty but with a new generation coming, we are trying our best to bring about efficient and effective systems. Bureaucracy is always there but we have to minimize it. (Kramer, 2016)

On the positive side, in the past decades, there has been huge infrastructure development including urban railway construction. In addition, Ethiopia is one of the countries that successfully met all the MDG goals (except one) set by the United Nations in 2000. Accordingly, by focusing on Agriculture and Education the country has managed to decrease its poverty rate by 1/3 as compared to the poverty rate in 2000 (WB, 2014).

⁵ <http://www.worldometers.info>

All telecommunication networks in Ethiopia are operated by a state-owned monopoly, which is the Ethiopian Telecommunications Corporation (ETC), which is under the Ministry of Communication and Information Technology (MCIT)⁶. ETC has recently launched a fourth generation (4G) mobile service in Addis Ababa while upgrading the 2G services to 3G in other telecommunication network coverage areas. In addition to the mobile service, ETC provides various types of Internet services such as dial up, CDMA (Code Division Multiple Access) 2000 wireless and wireless Internet using Aironet, VSAT (Very Small Aperture Terminal) and ENDO. As part of the ICT infrastructure development initiative, the government has started networking governmental organizations through projects known as SchoolNet, WoredaNet, and AgriNet. Moreover, with the thought of establishing synergy between private-government ICT initiatives, and to create good business climate, the government has launched the construction of an ICT village in which MCIT will have be headquartered. However, the growth of Internet and mobile services has been slow when compared to neighboring countries like Kenya and Uganda, with Ethiopia having an approximate penetration rate of 23% (GSMA, 2015). It is common knowledge that the mobile network in Ethiopia is intermittent and the signal strength is not even in all areas including the capital city. In addition, the price of mobile services is evaluated to be high when compared to neighboring countries and the average income of the population. Moreover, citizens' utilization of Internet services has largely been limited to social networking sites like Facebook due to poor development of governmental electronic applications. All these factors have great implications to the country's socio-economic transformation and need the urgent attention of the government if ICT should contribute to the socio-economic transformation the country is pursuing. This situation also has implications for those who want to build public health infrastructure on top of these underlying infrastructures; such as the HISP initiative, which this thesis is based upon.

In addition to the technical infrastructure, there are also socio-cultural challenges the country is facing due to the different calendar and alphabet. While the calendar is commonly known as the Ethiopian calendar, the alphabet, which is used in Ethiopia and Eritrea, is known as Ethiopic or Ge'ez script. The Ethiopian calendar is an extension of the Julian calendar that has 13 months. While the 12 months contain 30 days each, the 13th month is comprised of 5 days or 6 in leap year. It is seven to eight years behind that of the Gregorian calendar, which is the de facto international calendar. Amharic, Tigrigna in Ethiopia and Tigrigna in Eritrea languages use the Ethiopic script. In Ethiopia, the Amharic language and the Ethiopian calendar are the official working language and official date counting system respectively in public and religious organizations. This means that all technological solutions need to respond to this “uniqueness” if they have to be used in the country. Usually, NGOs use the Gregorian calendar although they work in Ethiopia making it necessary for ICT initiatives to provide IT solutions that entertain both calendars.

⁶ <http://www.mcit.gov.et/>

Bekele (2003) has described this issue effectively within the context of diffusing international standards to the Ethiopian context. Although some of the challenges he raised are now resolved as Microsoft has started supporting the Amharic language in the MS package, I will take the following quote from him to show the importance of a standard within the context of Ethiopia. Bekele wrote about the lack of a common encoding system as follows:

“Ethiopic electronic documents produced in the country are developed using mostly incompatible software based on different encoding systems, which makes information interchange very difficult. There is however a positive change going on. For the first time, there are a few Ethiopic software products that have started using Unicode. This will definitely facilitate document interchange. However, there is very little awareness among users who do not see the necessity of using Unicode based software. In addition to the problem of awareness, three issues deserve to be mentioned. First, let’s consider the difficulty of electronic document preservation. An encoding standard is important not only for information interchange but also for information preservation. The issue of electronic information preservation has been given very little importance in Ethiopia. Every organization has archives for its paper documents..... Conserving documents written using various encoding systems will create a great challenge for the future since there will be no software to read all these systems in twenty or forty years. If there were a single system, it would be possible for a central authority or even private companies to make sure that all new generations of software can read or at least import the documents written using the old system.” (Bekele, 2003, p. 14-15).

This quote shows the instrumental functionality of standards to bridge the past and the future. Countries like Ethiopia whose cultural heritages are not fully inscribed into global de facto ICT standards may engender not only digital divide but also a divide from their past.

In Ethiopia, the HISP project started in 2003 with a partnership between Addis Ababa University (AAU) and University of Oslo (UIO). Though it mainly involved staff from AAU, other students who received scholarships through the Norwegian Quota and NORAD schemes during the project commencement were involved in starting HIS work. It started through a Memorandum of Understanding between UIO and AAU. As typical action research informs us, the work started with a diagnosis phase of the phenomena at hand –HIS in Ethiopia. Then it was followed by DHIS customization, implementation, and scaling. Part of the student group, studied and implemented HIV/AIDS software for following up HIV/AIDs patients (Wondim & Nega, 2009). The output of the action research is reported as master theses, PhD theses or research articles. The work of HISP had been going on from 2003-2008 in the regions of Addis Ababa, Benishagul-Gumuz, Amhara, Tigray and Oromia. The software used was DHIS version 1. In 2007, the Ethiopian Federal Ministry of Health stopped the project with the intention of starting a more comprehensive HIS reform throughout the country following the principle of “one plan, one report and one Budget” (EFMOH, 2010, p.7). Being the coordinator of the Addis Ababa implementation from 2005-2007 and part of the action research before that, I recognized that the whole action research framework and participatory design of HISP were “foreign” to Ethiopia. What they called a “students project” was not a favorable form of collaboration for reforming the HIS at national level. Coupled with

other factors, which are elaborated in paper IV, these clashes of logic between HISP and the local context, I argue, led to the discontinuation of the project. The current involvement of HISP in HIS in Ethiopia is described in Chapter 5.

In 2012, the country prepared a National HIS roadmap with the main aim of promoting evidence-based decision-making and accountability (EFMOH, 2012). The roadmap places emphasis on the creation of interoperable IT systems with harmonized data from various sources, for example the Ethiopian Central Statistics Agency.

On the other hand, in the Southern Nations, Nationalities and People (SNNPR) region, there has been a continuous HIS strengthening effort by the John Snow Inc. (JSI)/MEASURE evaluation. JSI reports coverage of 6 zonal administrations and all Woreda (district) health offices by eHMIS in SNNPR. In addition, 44% of the health posts have implemented community HIS. After HISP's withdrawal from the HIS activity in Ethiopia in 2007, the main HIS activities have been taken over by a company known as Tulane University in Ethiopia (TUTAPE). They were assigned to assessing the human resource situation and development of HIS strategy in the HMIS/M&E Strategic Plan of the FMOH (EFMOH, 2008). In addition to the situation analysis, the company has been engaged in developing aggregate electronic HIS and an electronic patient record system known as SmartCare. In terms of capacity with respect to HIS, there has been a dramatic shift from the time HISP started in 2003. At that time, there was a clear lack of emphasis on HMIS issues, and that can be taken as a contributory factor for the weak HIS. Currently, there are two master programs that are targeted towards HIS. The one in Jimma University is particularly focused on Health Monitoring and Evaluation in collaboration with Tulane University and the Federal Ministry of Health. The second one was started by HISP in collaboration with Addis Ababa University (collaboration between the information science and public health departments) and it is on a Master level in health informatics. Logically then, this is something that can shift the current HIS norm within the public health care sector in the long run making the HIS standardization an important notion in HIS reform.

3.4 Background and HISP in Kerala and Gujarat

India is the largest democracy and the second most populous nation in the world next to China. It is a highly diversified country in terms of culture, language, religion and economic development across the various states. Following federal political structure, the 28 states share power with the central government. The country is home for 1.3 billion⁷ people.

⁷ www.cia.gov

HISP India, with the vision of strengthening the health information systems in India and the South Asian region⁸, was initiated in December 1999 in the state of Andhra Pradesh (Braa & Sahay, 2012). It is a not-for-profit organization having a close collaboration with the global node in the University of Oslo. The work in this thesis has drawn upon the HISP initiatives in Gujarat and to a lesser extent in Kerala.

3.4.1 Gujarat

Gujarat is a state on the west coast of India with an estimated population of about 62.7 million (as per census India, 2013). The state is in the forefront of economic and infrastructure (including e-infrastructure) development in the country, reflected in the fact that nearly all district and sub-district level health facilities have computers, and there is internet connectivity available down to the sub-district (called block) level. With respect to the organization of primary health care delivery, the state is divided into six sub-national regions, 26 Districts, 250 Blocks, 950 Primary Health Centers (PHCs) and 450 Community Health Centers (CHCs). Each PHC has under it about 5-7 Sub-Centers (SCs) that are responsible to provide outreach based services to the community. Generation of health information starts at the SC, which is the first contact point between the community and the primary health care system. Field level male and female nurses are expected to visit the villages assigned to them (one nurse typically is responsible for a catchment population of 5000) for providing various public health related services such as related to deliveries and immunizations. Data generated through this service delivery is first noted in the field diaries then posted to various registers (typically about 15 to 20 in a SC relating to Malaria, TB, Family Planning, and mother and child health. In Gujarat, I had a chance to attend meetings with the state minister where HISP India presented their work. I followed up on the way the staff from state, including the minister, and the HISP staffs interacted and resolved technical problems. This observation, coupled with interviews and discussions with co-authors, led us to conceptualize the Gujarat HIS integration effort within the concept “social capital”.

With this brief but sufficient for my purpose description of Gujarat, I will move to the next research setting in HISP India, Kerala.

3.4.2 Kerala

Kerala is located in the southwest coast of India with a population size of 38.8 million (as per census India, 2013). It is the most advanced state in socio-economic development indexes; such as poverty level, literacy rate (100%), and other population health status indicators. It has a maternal mortality ratio of 81 and infant mortality rate of 12⁹ (NRHM, 2015).

⁸ <https://www.hispindia.org/>

⁹ Health indicator data for Gujarat and Kerala was taken from the National Rural Health Mission webpage: nrhm.gov

The Kerala government¹⁰ has built an e-infrastructure called Kerala State Wide Area Network (KSWAN) connecting the districts, blocks and other offices to integrate a large number of governmental electronic services. The strong FOSS spirit in Kerala is an integral part of the free political system the state is pursuing. The government of Kerala has been cited for having explicit preference for FOSS solutions for building an inclusive and knowledge based society (Lewis, 2007). The following is extracted from the state's Information Technology policy (2007)

2.10 The Government realizes that Free Software presents a unique opportunity in building a truly egalitarian knowledge society. The Government will take all efforts to develop Free Software and Free Knowledge and shall encourage and mandate the appropriate use of Free Software in all ICT initiatives.

6.7 Free and Open Source Software will be used in all government funded ICT e-governance projects to the maximum extent possible. Preferential treatment will be given to FOSS as it enables the knowledge to be used democratically, makes software accessible to everyone and is economical.

7.6 Considering the growing economic opportunities happening around FOSS, the government intends to develop the state as the FOSS destination in the country. In order to achieve this, the government will provide special incentives to companies developing Free and Open Source Software

8.5 International Center for Free Software and Computing Development: the government intends to build an International Research and Development Center for free software and free knowledge in collaboration with other countries

The Kerala draft IT policy (2012) requires the use of open document in the government offices for facilitating document exchange. This is articulated in the policy document as follows:

5.1.6 open standards will be adopted in all e-governance solution

The strong emphasis on FOSS products was an advantage to start the FOSS based initiative in Kerala in 2005, making Kerala the first place in the HISP node to implement the DHIS2 (Braa & Sahay, 2012). Miscione and Johnston (2010) argue the convergence of HISP's logic of FOSS as an ICT solution for health with the government policy to be a source for establishing collaboration. They argue as follows:

In spite of the substantial divergence of final scopes, reliance on FOSS from both sides facilitated the establishment of cooperation with the state of Kerala, whose positive orientation toward FOSS is clearly expressed by official documents (like the one quoted above). Reference to common principles helped the continuation of collaboration (p.49)

However, the real implementations of the policies into practice seem to be not without any problem. In their assessment of the factors that influenced the utilization of open source products in the India education system, Sooryanarayan et al. (2014) concluded, "the use of open source is very less and significant efforts may be required in spreading awareness of the benefits of open source" (p.252). After receiving assistance from the HISP India team regarding DHIS for several years, the state government has recently taken ownership of managing the software for their need. Therefore, there is no HISP project in Kerala at the time of this thesis writing.

¹⁰ <http://www.itmission.kerala.gov.in/>

3.5 Background and HISP in Tajikistan

The republic of Tajikistan is a landlocked country that is found in central Asia. It became independent in 1991 after the collapse of the Soviet Union. The country has 8.2 million people (as per census Tajikistan, 2013) and the official language is Tajik. Just after independence, the country went through a civil war for 5 years, which contributed to the slow health system reform progress as compared to neighboring Kazakhstan and Kyrgyzstan (Mirzoev, Green, & Newell, 2007). As a result, the country's health progress is among the lowest in Europe and Central Asia although it is showing progress towards some key health indicators (WB, 2012). For example, Infant Mortality Rate declined from 65 per 1,000 live births in 2015 to 34 per 1,000 live births in 2012 (WB, 2012). The Tajikistan health system is organized with three management levels – national, regional (oblast), and district (rayon).

Tajikistan inherited a highly centralized and hospital-based system from the Soviet era (Mirzoev et al., 2007). The legacy of the Soviet Union is manifest in many forms in the lives of the people and the public sector of the country creating inertia for positive change efforts. Rechel, Kennedy, McKee, & Rechel, B. (2011) conducted a literature review to find out the continued influence of the Soviet past in the Commonwealth of Independent States (CIS) in which Tajikistan is a member. Their result revealed that these countries are still following outdated diagnostic procedures and treatment protocols, many with roots in soviet ideology and practice and that are in direct contrast with the western development influencing diffusion of standards –particularly procedure standards that originate from WHO. In their review, Rechel, et al. (2011) exemplified how the medical procedures the doctors in CIS followed did not comply with the WHO standard procedures. For example, “many children who would be classified as normal in international practice are subject to extensive surveillance and in some cases multiple treatments...often at the high cost to the family” (p.297). Though some of the practices, like involuntary treatment for alcohol dependency, have been discontinued in Russia, other former Soviet countries have it as a compulsory treatment procedure advocating practices that are not supported by research. This shows the continuation of the Soviet medical normative institutions that are resisting the diffusion of global medical standard procedures. The western medical practice was begun and has grown based upon evidence (ibid.). In relation to this Rechel, et al. (2011) write: “The practices that emerged in the Soviet period retain considerable support from hierarchical and outdated structures and scientific institutes” (ibid: p. 301). On the other hand, Tajikistan inherited an excessive number of doctors from the Soviet era and that helped to prevent experiencing a dramatic shortage of doctors after independence (Mirzoev et al., 2007) which is the aftermath experience of independence for many countries like Mozambique.

The HISP program in Tajikistan started in 2008 as a result of an invitation from the Asian Development Bank (ADB) to one of the HISP members to serve as an HMIS consultant. HMIS was part of the Bank's bigger health care reform project in Tajikistan. Our study documents the

beginning of the HIS strengthening effort. The following figure shows the research settings and the relationship with each other.

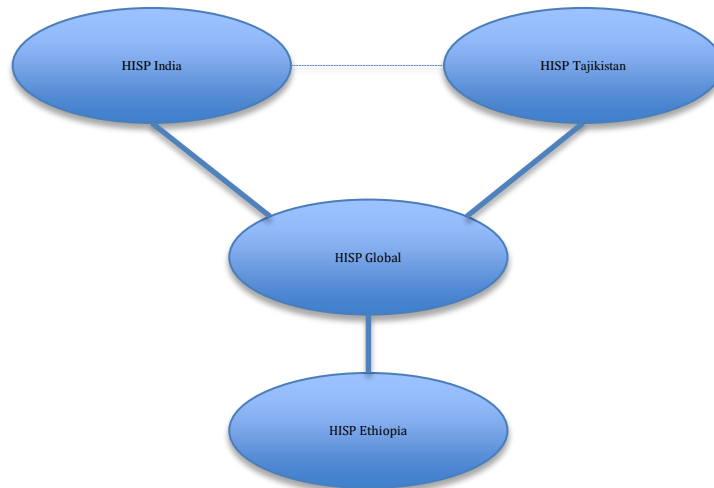


Figure 3-1: Research settings and their relation with the global and other nodes of HISP

3.6 Standardization within HISP

In HISP, standardization has been researched mostly in indirect ways or by analyzing one stage of the process (e.g., scaling, institutionalizing) than explicitly despite its importance in building national integrated health information architecture (Braa & Sahay, 2012). Some of the few studies that have addressed the notion of standardization within the HISP framework include the work of Jacucci et al., 2006; Braa & Hedberg, 2002; Braa et al., 2007; Braa & Sahay, 2012; Latifov, 2013 and Gizaw, 2014. In addition, the book by Braa and Sahay (2012) presents three cases of standardization from South Africa, India and Sierra Leone. A summary of that action research based standardization is presented below.

In South Africa, the local “HISP was responsible for efforts towards standardization and software development. Standardization efforts aimed at developing minimal datasets—a uniform and minimal set of data elements (a dataset)—with clear definitions to be reported by all health facilities, using simple paper reporting forms” (Braa & Sahay, 2012, p. 75). Standardization was achieved as a bottom-up participatory approach that had grown into a national strategy in 2000. They also created local networks that help to support local adaptation of standards (Jacucci, et al., 2006). HISP South Africa is known to be the strongest link with in the HISP network from the HIS work they have achieved in South Africa and in other African countries.

In India, the same approach could not be realized although there was a need for going towards action driven HIS. HISP has been working with the state health departments, which did not have the mandate to change what is being collected. Therefore, HISP India, a not-for-profit node of the global HISP, automated the HIS in the existing situation. Windows of opportunities for data standardization came when a national organ was established having HIS as part of the work. However, the software has not been taken as a national standard yet. Integration started by creating a facility-based dataset and integrating the two vertical programs promoting a phased strategy of incorporating other vertical programs.

The point of entry for HISP standardization using the DHIS in Sierra Leone came as a result of an invitation by HMN to reform the existing HIS. Sierra Leone was HMN's pilot country. In 2008, DHIS replaced the fragmented electronic information systems such as CRIS and Epi info as the staff stopped using those systems. In terms of dataset, a maximum dataset was produced by replicating the paper formats in the DHIS and by removing the inconsistencies behind the scene. This means, for example, that although the same data element appeared twice or many times in the paper format, it would be entered only once in the computer. Sæbø (2013) writes about the situation as "The redundancies and duplications between the various forms had been solved behind the computer in DHIS2 ...once data was entered for one form...it would automatically show up in other forms without the need to be entered again" (Sæbø, 2013, p. 59). In this way, the same data value will be registered for each data element resolving one issue of data quality-consistency. Braa and Sahay (2012) discuss the process in this way, "In January 2009, a workshop with all the important stakeholders, program managers and district representatives, agreed on revised and integrated data collection tools and data and indicator sets" (p. 80). By creating an attractor, which is a working system, which produces quality data, it was possible to draw other organizations like UNICEF to join the data warehouse. In another case, drawing material from Ethiopia, Thailand and South Africa, Braa et al., (2007) suggest a flexible standard as an attractor for drawing other stakeholders to join the standardization processes.

Same standardization processes by HISP had been conducted in other countries like Mozambique, Vietnam and Botswana with varying outcomes (Braa, et al., 2007b). In Mozambique, the unsuccessful standardization outcome was attributed to the lack of HISP members' ability to convince the health authorities. While in Botswana a maximum dataset approach was adopted as opposed to the minimum in South Africa, in Vietnam an agreed upon shared data set was developed for MDGs in a thought to motivate more works towards a minimum dataset.

The above examples are on data standardization within HISP and the outcomes show that achieving the HISP mantra of "minimum essential dataset" at each level of the hierarchy has been for the most part unachievable and is something foreign for the health managers to adopt it easily without long-term negotiation processes.

However, I also see the making of the DHIS software and the current expansion as the making of a de facto universal standard, which is facilitated by open generification (Gizaw, 2014). Open generification is about designing what is common for many users and leaving the particularities to be appropriated within the countries partially resolving the universal and local tension that has been surrounding the IT technology adoption and diffusions. This strategy is something that has created network effects attracting new adopters. Therefore, the generic software can be called another attractor for the diffusion of a standard IT technology in many countries and other organizations with a need for a Monitoring and Evaluation tool.

With this background information on the Health Information System Program (HISP), the District Health Information Software (DHIS), and the countries where the research was conducted, I will now move to the next chapter, which discusses the research method I followed to conduct the study.

Chapter 4 Research methods

This chapter presents the methods that were followed to conduct the research. The first section provides the research perspectives and its application in my research. In the second section, I will discuss the multiple case studies the research followed. The third section discusses the data collection techniques that were used as a means to generate data on the various aspects of standards and standardization. Finally, the last two sections are dedicated to describing the data analyses.

4.1 Research perspectives and their applications in this thesis

Broadly, a particular research project can be designed to follow qualitative, quantitative, or a mixed research approach depending on what the researcher wants to find out (Silverman, 2005). These researches can differ by the data collection, analysis and writing procedures (Creswell, 2003). Accordingly, while quantitative studies mainly depend on statistical analysis following rigid data collection procedures, qualitative inquiries explore in-depth opinions from participants in their own natural settings in a flexible data collection procedure (Creswell, 2003). Researches are classified as positivist, interpretive or critical (Orlikowski & Baroudi, 1991; Klein & Myers, 1999; Creswell, 2003; Walsham, 2006). Positivists, having its roots in the natural sciences, assume that “reality is objectively given and can be described by measurable properties which are independent of the observer [researcher] and his or her instruments” (Myers & Avison, 2002, p. 6). Most quantitative studies follow a positivist tradition. IS studies can be classified as positivist if there is evidence of formal propositions, hypotheses testing and the drawing of inferences (Klein & Myers, 1999; p. 69). As pointed out by Orlikowski and Baroudi (1991) most behavioral IS studies (i.e., studies of the interaction between technology and humans) in the old days reflected a positivist stance.

However, as the main aim of IS studies is to understand the dynamic interaction between information technology and organizations, and apply the produced knowledge to inform IS design and implementation, a positivist approach was not found to be adequate. Therefore, more researches in the past two decades have adopted an interpretivist tradition (Walsham, 2006). Unlike positivist, that encourages deterministic explanation of a phenomenon, interpretive studies attempt to understand a certain phenomenon through the meaning people assign to it by getting inside the world of those generating the phenomenon (ibid.). As such, action research is one of the preferred approaches to interpretivist studies. In IS, such studies “are aimed at producing and understanding the context of information system, and the process whereby the information system influences and is influenced by the context (Walsham, 1993: pp. 4-5).

While interpretivist tradition emphasizes the social construction of reality, critical perspective gives importance to the historical construction and emphasizes society or organizations not to be confined to exist in a particular state (Orlikowski & Baroudi, 1991). The central idea in critical

perspective is that “everything possesses unfulfilled potentiality, and human beings, by recognizing these possibilities, can act to change their material and social circumstances. And this potentiality for acting to change is constrained by prevailing economic, political and cultural dominations” (ibid, p.). Therefore, critical researchers argue that phenomena cannot be understood just by asking participants as done within interpretivist traditions. It is understood by also being critical to existing status quo, which constrains the action of the human agency to bring about change (Klein & Myers, 1999). Hence, critical researchers go beyond merely studying and theorizing to actively changing the phenomenon investigated (Orlikowski & Baroudi, 1991) as is done by action researchers.

My research follows a qualitative research approach and has been guided by both interpretive and critical research based philosophical assumptions. The interpretive approach was chosen, as the aim was to create an institutionally informed understanding of standardization processes within the HISs of developing countries. This was achieved through understanding and interpreting the meanings participants assigned to processes of data element definition and adoption of a standard electronic HIS. The interpretive approach also helped to get a broader understanding of the shared assumptions of users towards FOSS based solutions, which was, then, interpretively categorized within institutional frameworks. However, constructing an interpretive meaning of participants was not enough to understand the constraining and enabling institutions for a successful standardization process. In the field, as shown in the papers included in the thesis, we also looked at history and existing social systems playing enabling and constraining roles in change efforts at organizational level.

More specifically, the critical aspect of the research stems from the underlining assumptions that fragmentations of HISs are historically constituted and standardization efforts are highly influenced by exogenous factors that are usually outside the realm of the effort. I adopted a relatively one-way perspective that fragmentation of systems is adversely shaping the results of efforts to introduce effective eHIS, and there is an inherent need for standardization and integration. However, I acknowledge that changing this reality is complex, historically embedded, and constrained by various forms of institutional elements. While the interpretive perspective helps me to understand what are the meanings which the actors involved give to standardization and how it can be achieved, the critical perspective helps me to develop approaches that might have helped in addressing these issues keeping in mind the historicity of existing processes, and the politics that are inherently embroiled in them. Moreover, this research has also looked at how an institutional entrepreneur’s act of changing the status quo in HIS was constrained by the institutional context, which is one of the concerns of studies within critical research tradition.

4.2 Multiple case study: four cases

A qualitative research approach involves methods such as action research, case study and ethnography (Myers, 1997). As described in the previous chapter, this research is conducted under the framework of the larger action research program, HISP, which looks upon its initiative as “networks of actions” (Braa, et al., 2004) following a participatory process model (Baskerville, 1999). In action research, researchers collaboratively diagnose the social problem and collaboratively introduce change processes to alleviate or improve the identified problems (ibid.). The global action research of HISP is a composition of many location specific “nested action researches” that perform the collaborative need identification and change processes. Specifically, action research involves iterative cyclical phases of problem identification, action planning, action taking, evaluating and specifying learning (ibid.). The focus of the “network of actions” is to facilitate learning among organizations that are in the same institutional settings and that the learning will be used for cultivating generic software and formulate “best practices”.

However, I did not find my whole research project falling into an action research paradigm as my role as a researcher changed from an “involved researcher” to an “outside observant” (Walsham, 1995) during the course of the research. Two of the papers, nonetheless, have action research as an epistemological tool to investigate the challenges of standardization. While I was part of a “nested action research” in Ethiopia, I was a participant observant in the “nested action research” of India and Tajikistan. Hence, this research is a multiple case study within interpretive and critical research paradigms. Interpretive case study involves in-depth investigation of a phenomenon; “where research involves frequent field visits over an extended period of time focusing particularly on human interpretations and meanings” (Walsham, 1995: p. 74). The action research I was involved in created the possibility of conducting in-depth investigation. In settings where I was an “outside observant”, my coauthors, who were involved in action research, complemented the lack of frequent field visits that is recommended for conducting interpretive studies (ibid.). This is specifically true for the cases from India.

Ragin and Becker (1992) recognize a case to involve empirical units or theoretical constructs. Accordingly, in each research article included in this thesis, a theoretical construct of eHIS implementation from three empirical settings was taken to construct a multiple case study of standardization in health organizations. In this sense, I took my unit of analysis to be HISP’s work in the health organizations that have been going on in the multiple sites of Kerala, Gujarat, Ethiopia and Tajikistan. Thus, the study looked at the interaction of HISP as an intermediary in HIS standardization.

Furthermore, in 2015 (January-July), I conducted fieldwork in Oslo University Hospital to understand issues related to Electronic Medical Record transition looking at both technical and institutional aspects. The empirical work made me recognize the various activities Oslo University

Hospital have implemented to make a successful transition. That is the setting where the inspiration of conceptualizing standardization as institutional change came. The following table summarizes the cases, my involvement as a researcher and the main theme investigated at each case site.

Case setting	Researcher involvement	Theme of the case
Ethiopia	Involved in the full action research life cycle as a researcher and a full time employee	Bridging the gap between formal and informal institutions for standardizing and scaling HIS
Tajikistan	Involved in the initial phase of the action research.	Competing institutional logics as hindrance and vehicle to standardization.
Kerala/Ethiopia	Outside observant	Understanding institutional influences for adopting FOSS based software as standard in the two settings.
Gujarat	Outside observant	The enabling role of social capital for integrating reproductive and child health information systems.

Table 4-1: Cases, researcher involvement and theme of the case in relation to standardization

4.2.1 Case selection

The choice of these cases was mainly guided by ease of gaining access to data within the organizations. The fact that the health organizations in India, Tajikistan and Ethiopia had relationship with HISP provided me with the necessary access to do fieldwork in these organizations. During the whole of my fieldwork, I introduced myself as researcher and that the output of the research would be used for academic purposes.

In Ethiopia, I was involved as an action researcher and as an employee (2005-2007) of the BEANISH (Building Europe Africa Collaborative Network for applying IST in Health care sector) initiative. During this employment, I mostly worked with the Addis Ababa Health Bureau. In addition, I participated in national meetings. This situation enabled me to establish acquaintance with individuals engaged in HIS related activities that in turn provided me with sufficient knowledge over the area of my research interest. When I started my PhD I used data from this action research to form part of the PhD. The output from this process became an input for the first case by providing insight into identifying the formal and informal institutions and their relationship with HIS standardization.

In 2008, the action research approach we followed motivated us to theoretically understand the DHIS 2 rejection by the MOH of Ethiopia. We explored this within and outside the health care

sector. So we examined the ministry's decision to be guided mostly by the typical stereotypes of what constitutes an open source software initiative. This skepticism towards open source software was clearly put forward in the bid document, which stated proprietary software to be the only technological choice. It was again clearly put in the ICT document by policy formulating organizations. Discussion with my supervisor and a colleague (who was a PhD student) in Addis Ababa University, led us to think that there were certain shared assumptions that were surrounding FOSS products. Following an interpretive approach, we designed a research to understand those shared assumptions and propose mechanisms to change the status quo. For doing so, we needed a comparable case where FOSS products were promoted. Kerala was a known setting for that and the fact that it was under the HISP framework made us include India as a research setting. The findings of this paper served as a second case by identifying institutional elements that enabled or constrained the DHIS software adoption. We explored the case at macro and micro level.

As my interest was on standardization, I also wanted to investigate what other institutional facets could influence the standardization process if the national ministry was part the initiative. Tajikistan was a good arena for that. The fact that the Ethiopian HISP project stopped turned my focus to other national standardization processes still within the HISP framework. It became an important case, as there were similarities between Ethiopia and Tajikistan's HMIS. Both were data-driven rather than action-driven. Both needed a functionality to handle the International Classification of Diseases. I participated with groups of action-researchers from the University who demonstrated the DHIS software and who made the suggestions to reduce data elements. The drastic change process was expectedly difficult. We understood that there were competing logics that needed to be reconciled for standardizing the Tajikistan HMIS. The result of the action research formed the third case highlighting the importance of understanding competing logics during standardization initiatives.

As I mentioned in Chapter 3 – Research setting, the various research outputs on HIS pointed to the donor oriented vertical programs as being the source of such a fragmented HIS that generated a lot of redundant data. While I wanted to explore the meaning associated with the vertical programs, I found how institutional entrepreneurs could mobilize resources from their formal and informal networks to resolve technical problems to be a prominent issue. This became a fourth case to support my attempt to theoretically and empirically understand the standardization process that could be realized by bridging the gap between the informal and formal institutions.

4.2.2 Revisiting the cases

In 2015, I made an effort to revisit the cases to examine what had happened on the ground since the previous round of data collection. In Ethiopia, my recent involvement in the national initiative made the case revisit easier. In Tajikistan and India, I used document analysis and email correspondences with those involved in the HIS work to collect necessary data that helped me update my research output.

The revisiting of cases gave this research an element of longitudinal study. The underlying enabling structure that contributed for this longitudinal perspective is the HISP program, which has been running for several years as elaborated in the previous chapter. The acquaintances I established through this program were instrumental in exploring the cases in the current situation. In addition, the use of institutional theory to understand change processes can be better studied by following cases longitudinally than as a one-time case study. This is because institutions can be persistent and long-term perspective is needed to study them. Therefore, I revisited the cases to conceptualize standardization as an institutional change process. In the next subsection, I will discuss the methods I used to collect data for the cases and for building an overarching theoretical understanding on standards.

4.3 Data collection techniques

I used qualitative data collection methods such as interviews, participant observations, document analysis, company webpages, workshops, trainings, demonstrations and informal discussions in the three settings to collect data for the four papers included in this thesis. The case revisits, as mentioned earlier, mainly relied on email exchanges and websites visits to get updated information.

A number of interviews were conducted with the people working with HIS on a daily basis; software vendors, consultants, managers, people who were engaged in education sectors to understand from the respondents' perspective on what were the kinds of problems experienced, especially relating to standards. Interviews were semi-structured and they were not recorded. Extensive notes were taken mainly encouraging participants to openly express their views (Walsham, 2006). In total, more than a hundred interviews were conducted to build the cases materials.

In Tajikistan and Ethiopia, data were collected during the situation analysis, software customization and training of the DHIS software. Especially, the software customization process made visible the need for standards. It also helped the participants question the importance of some of the data elements, which were further negotiated with the relevant stakeholders.

Various types of documents were used as data collection means. This included reporting formats, indicator set, ICT policies, strategic plans, company brochures, and tender announcements. The following table summarizes the number of interviews conducted in each case.

Case setting	Interview data use	No. of informants
Ethiopia	To identify institutional factors that influence FOSS adoption	20
Kerala	To identify institutional factors that influence FOSS adoption	22
Ethiopia	To analyze institutional influence on standardization	47
Tajikistan	To analyze institutional logic implication to deinstitutionalization	16
Gujarat	To understand the implication of social capital to integration	14
Total		119

Table 4-2: Number of respondents and interview data use

4.4 Data analyses

Data analyses were conducted as a four-stage process of data constructions. The first two steps as described by Van Maanen (1979) cited in Walsham (1995) involves first-order construction of the interviewees about the phenomenon and second-order data construction of the researcher based on the first-order construction and using conceptual approaches (p. 75). In my research, the first-order data were constructed from interview results –diary notes. A thick description (ibid.) of the case was constructed for each case supplementing the interview result with data from other sources. The first order constructs were studied and analyzed independently and also together with my co-authors to find recurrent themes or issues. As such, thick description of the investigated phenomenon was presented.

The second-order construction of data was performed, when my co-authors and I tried to make sense of the first-order data using concepts from institutional theory. The result of the second-stage construct underwent several rounds of peer reviews during the publication process. Hence, feedback from reviewers contributed to the refinement and restructuring of the data.

The third-order construction of data was performed when I constructed “an institutional perspective of HIS standardization”. In this case, institutional elements/influences that pose and enable standardization in health organizations were extracted from each of the theoretical constructs (cases). Those were presented using three broad themes, i.e., formal-informal institutional gap, competing logics, and issues of legitimations. A fourth-order data construction happened when implications of the previous data construction were generated for both research and practice. The last stage shows the contributions of the research to the reference discipline that is a socio-technical perspective of IS studies. It also shows other contributions, such as to the analytical framework of institutional theory and to the literature on information systems failure.

Chapter 5 Research findings

This chapter presents the summary of the four research papers that are included in this thesis. The papers are summarized highlighting the main problems they addressed, the settings where the research was conducted, the findings, and their contributions.

5.1 Paper I

Mekonnen, S. M., & Sahay, S. (2008). An institutional analysis on the dynamics of the interaction between standardizing and scaling processes: a case study from Ethiopia. European Journal of Information Systems, 17(3), 279-289.

In this paper, we addressed standardization, which is among the most salient challenges confronting the implementation of effective HIS in developing countries. Understanding standards as a composition of uniform definition of data elements, uniform reporting formats, uniform flow of data; and uniform computerized information systems; we attempted to provide an institutional analysis of HIS standards. Douglas North (1990) distinction of institution and organization was used to build up the arguments. Within that framework, standards are seen as the rules of the game established by MOH/Regional health bureaus, by which other health service departments and external actors will play to perform HIS related activities. The paper focuses on the degree of overlap between formal institutions (attempts to establish formal policy on activities such as the definition of indicators and uniform reporting formats) and informal constraints in practice reflected in inadequate capacity –both technological and human, and existing work practices.

Empirically, the paper discussed the introduction of DHIS1 in Addis Ababa Regional Health Bureau. This work was preceded by extensive manual HIS improvement for effective implementation of the new eHIS - DHIS. Following the principle of “minimum essential dataset” and “hierarchy of standards” as part of the standardization process, we created a regional dataset by removing and consolidating some of the redundant data elements. For example, the age division in EPI data was eliminated. In other cases, the health workers used the occasion to include more data elements as a way of showing their work visible to the higher officials and to get more relevant information. For example, they added two more tetanus vaccination data elements to the regional data. This sort of tendency by the health professions led to increase in data element and ended up producing a “maximum dataset” as opposed to the “minimum data set” we strived for in the beginning. In addition to the individual needs of *showing their work visible* and the *relevance they established for each data element*, the process was affected by the relatively centralized and limited autonomy of the regions to bring about “formalized” change to their HIS. This was especially prominent in removing data elements, as it needed the approval of the national ministry. While the “maximum data set” approach helped us to cover all the vertical programs, reconciliation

as to their relevance to indicator generation was not possible without scaling the standard one level up to include the national ministry.

The other form of standardization was the creation of compatible data collection instruments at the health facilities. This includes patient cards, laboratory request forms, etc. at first level and then to registers and tally sheets at the next level. Data once registered in its primary form needed to be compatible with and fed into the next level and that the paper should be designed to support this compatibility. Understanding this, a new uniform and comprehensive secondary data collection tools were produced. Few primary data collection instruments were also designed and deployed by the region health bureau. However, due to resource constraints the standardization process could not scale to patient cards and other primary sources that were also relevant for generating quality data.

The third level of standardization was customization of the DHIS software to fit the Ethiopian context by replacing the other computer-based systems that were independently functioning supporting individual program's needs. These independent computer-based systems were not facilitating data exchange across the health departments horizontally and vertically. We viewed this layer as standardizing the technical systems. It specifically involved the work of adding a module, which handles Morbidity and Mortality using the ICD 6. DHIS facilitated data exchange by the import/export functionality from the lower level to the hierarchy up. As such, DHIS attempted to replace the use of Epi info and MS excel for HIS although not successful. The software was installed in the 10 sub-cities, 23 health facilities and in various units of the regional health bureau with full geographic scale. Currently, this hierarchical structure has changed with more health facilities and mode of reporting health data.

The last form of standardization that was required for a functional HIS was the standardization of the workflow or procedure standardization. This was about establishing one and legitimate data collection and reporting channel. It is also about preparing guidelines with respect to which data source should be used and establishing approval processes. Even though we thought we managed to create a comprehensive data warehouse, later, contrary to our intentions, two reporting channels were effectively performing the same HIS task. The vertical programs, such as family health, EPI and HIV/AIDS kept the status quo. The plan and program department, which was directly involved in the HIS reforming process, continued being responsible only for the ICD based morbidity and mortality data. The technical system, although covering the information needs of the vertical programs, could not scale to cover the other programs than the plan and program department. Disrupting the status quo needed a mandate more than what the region health bureau had. In this process, the region health bureau played a leading role by giving basic infrastructure such as computers and UPS to the health facilities and sub-city health departments. They also facilitated training programs.

Having the theoretical understanding as stated at the beginning of this section, the findings in the paper revealed that the effective standardization process of HISP in collaboration with the Addis Ababa and other Regional Health Bureaus was highly mediated by the institutional context in two ways. First, there was a gap in the formal and informal institutions. Second, the actors in the *HIS organization field* were not well aligned and that HISP was not legitimate enough to disrupt the status quo.

The gap between the formal institutions and informal constraints posed challenges to the standardization process. However, the *commitment of the region health bureau* in leveraging resource and continuously making efforts at changing the current situation was an important step towards overlapping the gap. This overlapping helped the diffusion of the standard within the legitimate mandate of the health region, which is down to the health facilities. However, this mandate did not help to diffuse the standard to cover the vertical programs, which was the task of the national health bureau, which was, again, in the process of creating its own formal institutions rather than building on the region's efforts. However, the Addis standard was used as a point of departure to create an HIS standard in other regions also.

By doing this analysis, we challenged the principle of “network effect” which did not play out in the public sectors. Addis Ababa is the capital city and well-resourced as compared to other regions. Therefore, there was an underlying assumption that what works in this region would likely be adopted by other regions as well. However, the in-country contextual difference, which widened the gap between the formal and informal institution slowed the diffusion process in the region. In addition, the national level with its legitimate role for undertaking such activities showed the greater role of mandate than network effects. We made a contribution to the IS literature by employing institutional theory to study change process, unlike the normal use of the theory to study stability.

Case revisit: My 2015 revisit of the case shows that after HISP's regional initiatives, the FMOH has deployed an electronic eHIS called eHMIS as presented in chapter 3. This eHMIS has been reported to have technical problems leading the Ministry to prepare for prototyping the DHIS 2 software in the country context. In terms of data standardization, WHO in the “Data Management” section of its online report writes “ data management could be considered “not functional”....MOH subunits lack integrated data warehouse” (n.d., para. 3 & 4). Therefore, the data standardization need and formation of a national data warehouse is something on which Ethiopia needs to focus.

5.2 Paper II

Sahay, S., Sæbø, J. I., Mekonnen, S. M., & Gizaw, A. A. (2010). Interplay of institutional logics and implications for deinstitutionalization: case study of HMIS implementation in Tajikistan. Information Technologies & International Development, 6(3), pp. 19-32.

This paper discusses the Asian Development Bank initiated HIS reform in Tajikistan. HISP researchers were involved as one of the authors, who is also an HISP member, was employed as a consultant. The work was focused on understanding the existing HIS situation, customizing the DHIS2 software, and pilot implementing the software in a district. Within these main activities, what was friction full was the notion of standardization although not explicitly stated as the theme of the paper. The four standardization types that were discussed in the Ethiopian case were also issues in Tajikistan. The HIS was data driven having around 30,000 data elements collected on a routine basis. As described in the Ethiopian case the standardization process here was also revolving around creating a minimum essential data set. HISP suggested the organization of the health data by category rather than by form as the form did not reflect the area for which the collected data would be used. However, it was very much resisted by the statistics office pressuring HISP to replicate the existing HIS in DHIS and to use one form as one dataset instead of reorganizing it. Further, the reporting formats were poorly-designed, comprised multiple sub-forms. We gave the example of one reporting format that had about 50 sub formats, containing 1,836 data elements and spanning 75 pages. These HIS forms that have been stable for about 75 years encouraged the health workers to design their own HIS manually making the data collection formats incompatible to each other and, hence, affecting the data quality. At the time of this research, HISP did not try to introduce any change process on the paper data collection instruments unlike the Ethiopian case.

Technically, we identified the presence of four computer systems that were not interoperable. One was called MedStat, which was used to enter and generate the 37 national reporting formats. The other one was WHO made software called Data Presentation System (DPS) for generating indicators. Further, there was software called Factor that was used to collect data on maternal health. All three were placed in the statistics division of the Ministry of Health at national level. MedStat was used in the district and provinces. The report generated by MedStat was then sent to both the central statistics office and the corresponding health program. Epi info was used in the TB program. Parallel reporting of the same data was revealed in the paper as both MedStat department and the health programs were reporting the same data to the level above them. These fragmented IT solutions were, then, consolidated by customizing the DHIS software that encompassed their function and that could give the potential for exchanging data with other software.

The IT led change process, having standardization at the heart, of HISP was impeded by the existing actuality of Tajikistan. Those impediments ranged from the poor IT resources in health

administrations/facilities to the poor attitude towards data and reporting, as is the typical reality of many developing countries. What was more prominent to the change process was what we conceptualized as conflicting institutional logic. The findings revealed two dominant institutional logics at play in this process, which were visibly contradicting each other as shown in Table 1 below.

Tajikistan HMIS logic	HISP HMIS logic
Central planning for statistics (supportive curative rather than preventive)	Decentralized decision making, based on routine data
Centralized structure rather than decentralized	HIS is indicator and action-led
Extensive data collection	Essential data set with flexibility for adding locally important data element while complying to the data needs of the upper level
Reliant on paper formats that are rigid	Computer based system for facilitating data aggregation, increase flexibility and decrease repose time to epidemiological information needs.

Table 5-1: Conflicting institutional logic

The logic inscribed in Tajikistan HIS was understood as the historical byproduct of the Soviet Union regime. The regime was known for being centralized, collecting detailed data, and had focus on a curative rather than a preventive health system. After the collapse of the Soviet Union, those institutions survived and were highly defended by the people responsible for the HIS. Replacing those institutions by the proposed HISP logic through the process of deinstitutionalization was impossible as there was no chance of removing even the duplicate data elements. HISP then devised a mechanism of maintaining the HIS status quo, by replicating the status quo in DHIS2, which was flexible enough to handle the HMIS as it was. It was believed that this process would make the problem more visible and other small step change processes would come in the future. The paper made contribution by showing how conflicting institutional logics may result in institutional change processes.

Case revisit: Efforts of reforming the HIS have continued till now with European funding under a project called “Technical Assistance to Support the Strengthening of the Health Information System”¹¹. This project has been implemented by EPOS Health Management (Germany) in consortium with ICON-Institute Public Sector (Germany), Oslo University (Norway), and IrfatC (Tajikistan). Making a recognizable progress on the country’s HIS, the EUR 3.4 million project has

¹¹ eu-hmis.tj

come to completion in January 2016. The findings of the PhD study of Latifov (2013; p.81), consistent with our earlier findings characterizes the Tajikistan HMIS as 1) overloaded with data and lacking standardized definitions and guidelines for data collection 2) lacking adequate revision and agreement on HIS standards 3) having weak information infrastructure that supports the HIS and 4) needing urgent institutional change process that rationalizes HIS use among stakeholders.

Upon my request for an update on the current HIS status of Tajikistan an informant responded with the following:

Currently HMIS implementation is coming to an end. Lots of work have been done continuing since work done by your team. Now, all forms are revised and reduced, especially indicator list is reduced to 460 out of which 40 are classified as primary, which are included in the national healthcare strategy 2010-20. All district hospitals are linked to the central database and are online on 7/24 bases. (Email received Sunday, October 25, 2015: 10:04 PM)

In general, the Tajikistan case shows how slowly the soviet legacy is dissolving from the HMIS arena. It is being replaced with new practices. For example, when we started the HMIS work back in 2008, the HMIS was found to be cumbersome and any change processes were heavily contested. The gradual transition is well exhibited by the number of indicator reduction within the past eight years and reorganization of the data sets/elements. Moreover, DHIS2 is being used as a national data warehouse. The issue here will be how to institutionalize the HIS standards so that the Ministry will continue updating and utilizing the system on their own without the donor's financial and expert assistance.

5.3 Paper III

Mekonnen, S. M., Sahay, S., & Lewis, J. (2015). Understanding the Role of Social Capital in Integrating Health Information Systems. *Journal of Health Informatics in Developing Countries*, 9(2).

The main aim of the paper is to understand the role “social capital” plays in integrating disparate instantiations of health information systems in the Gujarat state of India. This process was started as top-down processes within the state and using a “maximum data set” approach. The process was supported by the server based DHIS2 application. Apart from the challenge of shifting to indicator based HIS by reducing the data elements, the low maturity level of DHIS2 at that time posed challenges to the integration effort. Specifically, the team faced three sets of challenges: server, database and capacity. The server was slow partly because of technical reasons like the limited bandwidth in the state and partly due to the institutionalized practice of data entry during the peak working hours and at the end of the month. The server problem was exacerbated by the ever-expanding database size, which contained data elements with zero values for many consecutive months. Accordingly, HISP India made a suggestion to reduce the number of data elements

collected by removing the 70% “zero valued data elements”, which was not accepted by the organization. At this point, an HISP India staff member and principal actor joined NHSRC –a government of India think-tank on technical issues to the Ministry of Health. This gave legitimation to make changes in the health information systems, which was not possible in Gujarat.

In order to solve the technical problems, the HISP India team drew extensively upon the expertise of Oslo PhD/Master students and others that were part of the HISP network. On top of the formal network that existed by being a member of multiple institutions, individual personal relations boosted the team’s capacity to solve the technical problems and to improve the HIS. The gain from the personal relation was free of direct cost, making HISP India offer cost-effective solutions to the state. We conceptualized this cooperative problem solving approach as something gained through the use of “social capital” that has structural, relational and cognitive dimensions. From the client side, the status and the respect of the health commissioner made the work of HISP India visible nationally making it accepted by other states. The DHIS software served as platform for representing the shared meanings among actors involved in the HMIS work.

This paper made a theoretical contribution by pointing out the importance of social capital (not temporary like a project but a stable and extendable network) for integrating health information systems. Social capital gives actors the possibility of drawing on various kinds of expertise that are needed in such efforts. It also gives them important values such as reputation, legitimation, and trustworthiness making their actions more acceptable than when it was not mediated by those values.

Case revisit: My 2015 revisit of the case shows that the project I followed on was discontinued for the reason that the state needed a name-based pregnant women tracking system from HISP India. As their request was not fulfilled, the state developed another in-house system, which could fulfill their need of automating disaggregate data than the aggregate DHIS2. Therefore, there is no HISP project in this specific state at the time of the thesis writing.

5.4 Paper IV

Mekonnen, Selamawit Molla, and Zegaye Seifu Wubishet. "An Institutional Perspective to Understand FOSS Adoption in Public Sectors: Case Studies in Ethiopia and India." American Journal of Information Systems 4.2 (2016): 32-44.

Following the standard classification given in paper I, this paper shifts our focus from data and procedure related standards to one of technical. It argues that standardization process can be heavily influenced by the nature of the standard itself. This is because there are institutions that support and undermine the standard; thereby influencing its adoption and diffusion. By “nature”, we refer to whether the technical solution is Free and Open Source Software (FOSS) or a closed-

source proprietary solution. Despite the benefits, the use of FOSS products in the public health sector of developing countries remains limited. Hence, we attempted to theoretically understand the institutional dynamics surrounding FOSS products and then devise strategies for a “middle way” information technology field in the public health setting. The “middle way” refers to an institutional environment that takes into consideration both FOSS and proprietary software when choosing a technological solution.

We used the three analytical dimensions of institutions to assess how institutions influenced the adoption and diffusion of the standard in Kerala and Ethiopia. We complemented the three dimensions by also bringing into light the influence of the software via increasing returns. The key findings are presented under each institutional element as follows:

Regulative (have to): this institution influences the adoption and diffusion of technology by giving a sense to organizations that they “have to” comply to the established rules. In our 2007 analyses of ICT policy documents, we found out that there were explicit preferences to FOSS based products in Kerala. On the other hand, Ethiopia showed a clear preference to propriety software in the Ethiopian ICT policy and in the eHMIS tender document of the Ministry of Health. In 2015, Ethiopia briefly mentioned FOSS based products could also be alternative e-government solutions. In Kerala, the 2012 ICT policy still mentions the preference for FOSS products although not as firmly as the 2007 statement.

Normative (ought to): these institutions were indicated by the adverse effect they have on the adoption process. For example, in Ethiopia the general lack of capacity and lack of organized structure for FOSS products were mentioned as a basis for legitimizing to choose only proprietary software. This is because, in Ethiopia, there was a limited normative institution that guides and creates understanding about FOSS. Investigation of the curriculum confirmed that students were not well exposed to the ideology and frameworks of FOSS. The FOSS ideology is meant to create moral value to FOSS. For example, using public expenditure of developing countries in an appropriate manner and reducing pirate use of proprietary software, which is a common practice, at least in Ethiopia. In Kerala, there was better awareness supported by academic and professional associations. These were facilitated through professional associations and education systems. The absence of the same in Ethiopia meant that the health sector did not see any normative pressure to go the FOSS route. Although there was a FOSS professional association in Ethiopia, its influence on policy and norms was found to be rather limited. Further, in Ethiopia, there was a tendency of setting the normative role of the health sector to be only on health. This was used to legitimize FOSS nature as not having any added value for the sector.

In addition, in Kerala, the presence of intermediary institutions, namely Total Service Providers, to promote and mediate the implementation of FOSS served as an important ingredient in establishing a sense of duty and moral obligation that were necessary for institutional change. The case from

Ethiopia shows limited normative institution resulting in weak moral and duty obligation for FOSS.

Cognitive (want to): the paper found conflicting personal beliefs regarding FOSS. While those who are involved in such a paradigm hold a view that favors FOSS, others were rather skeptical. Those stakeholders justified their view underscoring the weak support of regulative and/or normative institutions. In Ethiopia, stakeholders at policy and ministry of health level viewed FOSS to come with hidden costs, poor support, and lack of appropriate expertise. In Kerala, there was a belief that “it is harder to learn others code anyway. So it does not matter whether the software is open or closed source”. Some programmers, however, disagreed and implied if supported by regulative and normative institutions, it would not be harder to break the habit of writing own code but build on others. What was an intriguing finding of the paper was that despite the strong regulative and normative institutions support in Kerala, and the absence of the same in Ethiopia, stakeholders in both settings shared more or less similar perception regarding the advantages and disadvantages of FOSS.

Technology (ought to have): this element was explored in relation to the adoption or not of DHIS in the health departments of Ethiopia and the state of Kerala. In Kerala, the early adoption gave credit to the enabling regulative and normative institutions. In Ethiopia, however, the weak support of those institutions contributed partially for the rejection of the same software. The current positive attitude towards DHIS in Ethiopia, and the need to go in the direction of the FOSS route, we understood, to be mediated by the technology itself through the process of increasing return as described by economic perspective of standards. This means it created a sense of “ought to have” DHIS. The software proved itself as a credible M & E tool in health by being adopted by many organizations, which contributed to the further improvement. This attracts others to get enrolled in the network to benefit from the existing social capital while contributing to the future development of the software. However, from the supplier side, there can be reluctance, as the return of enrolling new stakeholders would increase the opportunity cost rather than increasing the return.

The following table presents a simplified version of how the complex institutional environment that enables and constrains the adoption of FOSS in Kerala and Ethiopia.

Institutional pillars	Kerala		Ethiopia	
	Constraining	Enabling	Constraining	Enabling
Regulative	NO	YES	YES	NO
Normative	NO	YES	YES	NO
Cultural-cognitive	YES	YES	YES	YES
Technology	YES	NO	NO	YES
FOSS adoption	YES		YES	

Table 5-2: Institutional Influences on FOSS adoption in public sectors

As a strategy we recommended the combination of incremental and radical institutional change approach to create a new IT arena that takes the “middle way”. This means changing the formal institution in a radical way and employing a small step incremental change for the informal institutions. To this end, revising of the IT education curriculums and the presence of strong professional organs in Ethiopia may lead to the required change by establishing roles and responsibilities that give a sense of moral obligation which is one of the mechanisms to bring about institutional change. Theoretically, the paper adds on the few studies that draw upon institutional theory to understand both stability and change. It particularly adds to the quite a few studies (Hsu et al., 2015; Palthe, 2014) that employed the aforementioned institutional elements to understand institutional change processes. It further expands the institutional framework to account technology as an institution and that it plays a role in changing the norm, regulation and perceptions.

In the next chapter, I will present the syntheses and discussions of the findings of the research papers.

Chapter 6 Syntheses and discussions of the findings

In this Chapter, I will present syntheses and discussions of the findings to be able to respond to the research question. In the first subsection, I will present the process and outcomes of the HIS standardization in the four cases. In the second subsection, I will present the institutions that shape the standardization process.

6.1 HIS standardization in the four cases

Here, I will present some common issues that are relevant for the outcome of the HIS standardization in the four cases. Those are: how the process in each setting was initiated, and at what level of the organization it was started, and what was the final outcome of the process.

6.1.2 How the process was initiated

The HIS standardization process was started by different organizations in the three countries. In Ethiopia and India it was through the collaboration of the respective HISP local teams (HISP Ethiopia & HISP India). While HISP Ethiopia was a collaborative project between HISP global at the University of Oslo and Addis Ababa University, HISP India was an independent non-for-profit organization. In Tajikistan, the Asian Development Bank owned the HIS reforming project. Subsequently, they hired a consultant who was part of HISP India and HISP global. The link with global HISP led to the entrance of more stakeholders who participated in the HIS reform. This laid the groundwork for continuing the HIS work with other organizations after the consultancy period was over (Paper I, II, & III).

6.1.3 Organizational level at which the process started

Given the hierarchical nature of the health care sector, the standardization process started at the state level in Gujarat and regional level in Addis Ababa (Paper I & III). In Tajikistan, HIS standardization was started at the national level. Later, there was a national HIS standardization in which a member of HISP India got involved (Paper III). DHIS is not a national standard, but a standard for some states in India. In Ethiopia, the process has now started at the national level.

6.1.4 Outcomes of the standardization

Among the three HIS standardization facets—data, procedure and tools—data and procedure standardization were found to be the most salient. At the beginning, a standardization attempt was aimed at creating a “minimum essential dataset” following the principle of hierarchy of standards. However, despite the historical and cultural differences of the countries, a “maximum dataset” was produced which could satisfy all the involved actors but not optimal for the performance of the HIS (Paper I, II, & III). Even data elements with zero values for consecutive months were contested

from being removed from the database. In Tajikistan, the continuous effort led to data element reduction and the new ones are linked with the indicators they generate (Paper II revisit). In Gujarat, revision of the forms and integrating one vertical program was achieved when the process started at national level.

In terms of technical tool, while DHIS1 was implemented at the region level in Addis Ababa, in Gujarat there was a transition from DHIS1 to DHIS2. DHIS 2 has been a national de jure standard in Tajikistan and a state level M & E tool in Kerala.

Apart from the electronic and data standards, during HIS standardization there was a need to make compatible each of the data collection instruments in each level with the patient card, laboratory reports, etc. This was partially done in Addis Ababa (Paper I). However, compatibility could not be kept at all levels due to resource constraints. Currently, all the forms are also revised in Tajikistan. Next, I will present the institutions that led to such varied outcomes in standardization.

6.2 Institutional influences on HIS standardization

The research question set in Chapter 1 was: *How can institutions enable, constrain and shape HIS standardization in a developing country context?* Those are responded to under the three themes: gap between formal-informal institutions, competing institutional logics, and issues of legitimation.

6.2.1 Gap between formal and informal institutions

Drawing from the three cases formal institutions, are represented as agreed upon data standards (i.e., dataset and indicator), HIS tools (i.e., manual reporting formats and the DHIS), and agreed upon procedure for data collection and reporting. Taking the health organization as a point of departure, these are de jure standards that are formed in collaboration with HISP and the corresponding health organizations. Their implementations were mandatory within the health organization or within the level the health organization has mandate to reorganize the HIS.

Although *coercive* in nature, the formation, diffusion and use of such standards, are heavily dependent on informal constraints such as existing capacity, perceptions towards HIS in general and the nature of the eHIS particularly (Paper I & IV). How the nature of eHIS influences standard adoption is discussed in the next subsection.

HIS standardization is particularly influenced by the existing *vertical and hierarchical* health care arrangement, which does not allow change in the dataset at the lower levels as stipulated in decentralized health care arrangements without involving the national ministries. Neither districts nor regions (states) have mandates to make modification in the existing data and procedural standards (Paper I & III). As a result, the HIS standardization process resulted in a “maximum data-led dataset” contrary to “minimum action-oriented data set”.

The implementation of regulative institutions is also dependent on the availability of appropriate infrastructure such as computers. *The larger the gap between the formal and informal institutions, the less likely the standards will be followed despite their coercive characteristics (Paper I).*

This finding is consistent with the findings of Piotti, et al. (2006) who attributed the challenge of implementing HIV/AIDS information system standards to the large gap between the formal institutions and informal constraints. Bratton (2007) emphasizes, in Africa, informal institutions govern the human interaction more than formal institutions. Therefore, in order to overcome the challenges related to informal constraints, first, it requires *strong management commitment* to leverage resources to overcome both routine rigidity and resource constraints (Paper I). Regarding this, Bala and Venkatesh (2007) argue firms that are not aware and committed to overcome their resource and routine rigidities are less likely to adopt standards. For example, the cumbersome data set that was the result of strong focus on vertically managed information systems and low computer skills at the health facilities were improved by the management focus on training and consensus-building meetings (Paper I). However, although a central data warehouse using the DHIS1 was created at the plan and program department, it was not used by the other health programs. The need and awareness of data exchange among the health departments was poor and favors the status quo. *Hence, addressing informal constraints requires cultivation of data sharing culture among the stakeholders in the HIS institutional context using education and continuous training.*

Second, it requires the ability of institutional entrepreneurs to recognize the informal institutions and adapt the standardization project to benefit from action constraining institutions. For example, paper III shows how informal relationships (friendship & trust) were used to provide cost-effective services to the public sector. It was also used to build local team's capacity to cope with the technical challenges they faced when they shifted from DHIS1 to DHIS2. Therefore, extending Braa, et al. (2004) arguments of effective actions to be taken through networks, this research suggests the network of actions to consider also informal relationships as they are equally important in facilitating learning and technical problem solving in ICT based initiatives. The value extracted both from formal and informal networks for achieving standardization I recognize as the value extracted from social capital. HISP has invested several years in building stable networked relationships across the world, which is giving back to the efforts of making the DHIS software as emergent de facto standard and to resolve informal institutional and resource constraints by mobilizing resources. In addition, Paper III emphasized the need for being a member of multiple organizations as a way to resolve routine rigidity challenges.

The findings in the papers also showed the interdependence of the various standard facets and how the flexibility and rigidity of one can become an impeding or enabling factor to the diffusion and assimilation of the other. For example, the flexibility of DHIS handled the rigid datasets as shown in Papers I, II and III by adopting a "maximum data set" approach. The "maximum data set"

approach was not an optimal solution for improving the health care provision. However, it recognizes the opposite role of the existing institutions' rules, norms and perceptions. The underlying assumption at the beginning of all these initiatives, as described in the papers, was bringing change over time. While in Tajikistan the sought change process needed continued effort by various stakeholders who could leverage resources for almost eight years, in Gujarat, it was initiated again. The latter is discussed in subsection 6.2.3.

6.2.2 Competing institutional logics

Standardization in all phases involves recognition and reconciliation of institutional logics that stems from the various stakeholders that are involved in HIS activities. The healthcare system is encompassed with diverse institutional logics that embody the organizing principles, value and belief of how to perform tasks (Currie & Guah, 2007). These logics have implications on HIS standardization. The study demonstrates three sets of logics that are dominant in the standardization of HIS. The logic of HISP, the logic of those who work on HIS in the different countries and the logic of those who are involved in software development and ICT policy matters.

In Tajikistan, the HISP team recommendations of shifting towards indicator-based data collection practice was not understood by the statistics department, which was accustomed to collecting large amounts of data in case they would be needed in the future. Those were a continuation of the past Soviet Union health care arrangement, which was geared towards curative care and detailed data collection. Redesigning the software to accommodate such kind of detailed and multi-dimensional data elements appropriated the logic of the MOH. This facilitated the adoption of one dimension of the HIS standard -the DHIS2. Standardizing the other dimensions of the standard needed the appropriation of the HISP logic for which the health organization was not ready. At that time, HISP established a group, which could continue the effort of strengthening the HIS by focusing on the current value rather than future value of certain data elements. The project continued with another donor after ADB and the logic held by the statistics department has been slowly replaced with a logic similar to that of HISP.

The other competing logic was the logic that stemmed from the nature of the IT solution. HISP follows the principle of FOSS for the public health sector. The underlying assumption is FOSS products are freely available and the source code can be changed according to need. This logic was compatible with the logic of Kerala ICT policy makers and FOSS professional associations. In Ethiopia, the prevailing logic held by ICT policy makers and software developers was that "FOSS products are not the preferred software in public healthcare." This logic led to the rejection of the software. The logic has prevailed until technological and functional pressures have now come, which may make DHIS2 a preferred M & E tool despite its open nature. The current shift of logic compels one to look into the other HISP logic which is participatory action research. In Ethiopia, as discussed above, the project started with a link of academic institutions and having PhD and Master students, as both researcher and action taker. This was not very well accepted by the MOH.

They viewed HISP as a students' project that will not be able to support the health care sector in a sustainable way. Therefore, in addition to the conflicting logic regarding the nature of the software, the participatory action research tradition of HISP was “foreign” to the Ethiopian health and education system.

In addition, Paper III demonstrates the conflicting logics of the health professionals and the HISP India team regarding “zero data value”. The HISP team argued those data elements that contain “zero” for several consecutive months are indicators for non-use and that they should not be collected or saved in the database. HISP’s intention was to optimize the database and in a way start first level data standardization. The health workers argued against that. On the other hand, the health workers found it useful and meaningful to register zero values and that they needed to continue the status quo unless the national level removes those data elements.

As a strategy, the institutional influence of competing logics on standardization process was tackled by continuous efforts coupled with flexible software and mutual learning. It was also argued that it was a necessary step towards deinstitutionalizing the existing HIS institutions. The learning from Tajikistan and Ethiopia made the software handle ICD based morbidity and mortality data in a flexible way. Therefore, the study implies that *institutional logic is not static but in a continuous change process being at odds when new entrants come to the organizational field*. In a similar vein, Currie & Guah (2007) studied how institutional logic influences the adoption of a technical solution in the National Health Services (NHS) of the UK. The shift of logic in NHS towards patient centric health care delivery, the authors argue, require the technology to be suitable to the new members (i.e., citizens of UK) logic too; influencing its design, adoption and use. The conflicting institutional logic with respect to how money should be spent across the NHS has also been reported as contributing to destabilizing the steady progression of the national program for IT (ibid.)

6.2.3 Legitimacy

The other institutions related influence on HIS standardization could be described with the notion of legitimacy.

In Ethiopia, Addis Ababa, the data standardization produced the same result as Tajikistan. An additional module to accommodate Morbidity and Mortality dataset using ICD6 was developed in DHIS1. However, full data standardization was left to be done in the future following an incremental change process and by enrolling relevant stakeholders. This process was not materialized as neither HISP nor the region health bureau had the right legitimacy to perform a full-fledged standardization. Legitimacy would be gained only by starting the process from the MOH. That was not possible as there were other competitors that were keen to do the same HIS improvement work. The other competitor followed different organizational and software

development approaches, which seemed more aligned to the norm, rules and perceptions of the MOH specifically and the society at large. For example, the company, which took over the software development process, alienated the software development process from the education and the health sector as opposed to HISP's approach of creating links among these sectors following an action research project. In addition, the company used proprietary software as a national eHMIS, which was again consistent with the Ethiopian context given the poor infrastructure and human resource capacity with respect to FOSS technologies. Therefore, there was no input legitimacy for HISP and that its use of DHIS2 was surrounded by a great design-reality gap. However, the long term effectiveness of HISP's approach to transform the institutional context and its probable contribution to the national development was not critically evaluated, making the process more legitimacy oriented than increasing organization efficiency. Therefore, the HIS standardization was stopped at diffusion stage after covering only four regions and at assimilation stage within the Addis Ababa region.

The other legitimacy issue comes from the Gujarat case, where data standardization could not be done without the formal endorsement of the national level. However, space of opportunity to make changes in the dataset came when an HISP India team member joined a national organ that has HIS improvement as a task. In Tajikistan, input legitimacy was gained as the process was started by a donor agency, which functioned at the national level. These are phenomena which do not lend themselves to network and crowd effects for formation and diffusion of standards. Hence, it compels us to look into the sociology of standards that has legitimacy as a core component (Timmermans and Epstein, 2010; Botzem and Dobusch, 2012). However, the current case of Ethiopia shows how the large DHIS user base has given input and output legitimacy for the diffusion of the software in the country. The case specifically informs how the FOSS nature seems to become irrelevant once the software reached matured development level. It is, however, worrisome since it seems the value of co-creating and extending the software that comes together with the open nature is not given any value.

In summarizing the findings of the study, institutions influence standardization process in three ways:

1. When informal constraints (i.e., norms, values, perceptions, shared assumptions) are not addressed and the gap between the formal and informal institutions is not overlapped.
2. When competing and dominant institutional logics among stakeholders are not recognized and strategies are not devised to reconcile them in a mutual learning process.
3. When the standardization process cannot gain input legitimacy from relevant stakeholders, such as National Health Ministries, due to misalignment with the existing institutions such as the regulative, normative and cultural-cognitive of the country.

The study suggests the need to conceptualize standardization as institutional change, which is a broad two-staged process of deinstitutionalization and re-institutionalization that is filled with small-scale transitions. Institutional change requires:

1. Strong management commitment that is aware and willing to overcome routine and resource constraints
2. Understanding and learning dominate heterogeneous logics in standardization process
3. Recognizing standardization not as a static and closed process but as an open, inclusive and continuous process that follows an adaptive approach
4. Network building both from formal and informal relationships
5. Modularized and flexible standards for bringing institution sensitive small-scale changes

These findings lead us towards the following chapter that elaborates the aforementioned conceptualization.

Chapter 7 Contributions and conclusions

By doing this research, I intend to contribute to research and practice in the area of IS standardization studies in general and IS studies that use institutional theory specifically. The chapter is divided into three subsections. The first subsections present the theoretical contributions of the thesis. The second section presents implications to practice, and the third section contains conclusions and implications to future research.

7.1 Theoretical contributions

7.1.1 Technology as the fourth institutional pillar

The first theoretical contribution of the thesis is re-positioning technology in institutional theory. So far, socio-technical perspectives that employed institutional theory as a theoretical framework have been skewed towards social aspects. They mostly describe how the surrounding environment has enabled and constrained the effective implementations of technological solutions in organizations. Others, such as Kling and Iacono (1989), Avgerou (2002), Fountain (2004) characterize technology (electronic information systems) as institutions of themselves. They argue, “ICT applications are taken-for-granted as fixture of contemporary organizations. Their value has become a ‘rational myth’” (Avgerou, 2000, p. 238). Even though, they acknowledge the value of technology in transforming the society, in the analytical framework of institutions by Scott (2001) and the causes of organizational Isomorphism by Powell and DiMaggio (1991), the kind of technological force for transformation is overlooked and technology is treated as only a material resource that processes input to output.

The empirical data in this thesis suggested that technology by itself could influence institutional change processes in two ways. First, as described above, it plays an invisible negotiating role to reconcile competing logics. Second, it creates technological pressures (given a large installed base) that influence the decision-making process which further fuels institutional change. The logic behind this, as discussed in Paper IV, is “ought to have” the technological solution because it has proved to be credible by being adopted by many similar organizations. The indicator for this is the *large installed base* and the basis for compliance is *credibility and increasing return*. Therefore, I suggest, Scott’s typology of institutions to also contain a fourth pillar, which is “technology” to make it a comprehensive analytical framework for studying institutional change processes that have technology as a central component. My use of technology here is in reference to the DHIS2 software and the current large user base. In addition, I recommend the institutional pressure that makes organizations Isomorphic to be complemented with technological pressure as well. The suggestion adds onto the few IS literature that views technology as institutions. In addition, as

opposed to the literature, the thesis highlights the need to treat it on its own rather than taking it as a cutting across institutions that have characteristics of norm, rule and cultural-cognitive. It is worth mentioning, however, that there is no clear demarcation among these institutional elements and that the presence or absence of one can facilitate or impede the evolution of other institutions and standards.

7.1.2 Standardization as institutional change

By conceptualizing standardization as institutional change, I seek to contribute to the call of Lyytinen and King (2006) and Narayanan and Chen (2012, p. 1395) for an institutional study of standardization. In addition, Timmermans and Epstein (2010) emphasize the research gap in addressing standardization from a sociological perspective that is attentive to the complex institutional configurations and negotiations that promote and inhibit standard formation, diffusion and use. Moreover, the role of professional associations in bringing institutional change is indicated as a research gap (Mignerat and Rivard, 2005). I seek to fill that gap as well by taking HISP as a network of multidisciplinary experts that provide guidance and co-create/co-customize open source software to improve the HIS of developing countries. The conceptualization is based upon the integrated framework in Chapter 2 (Figure 2-3).

When I take an institutional perspective of standardization, I am looking at standards as institutions. Therefore, following the institutionalists' argument, standardization is both enabled and constrained by the already existing institutions. Hence, in order to make institutions, one needs to change institutions that are constraining the formation, diffusion and use of the new one. To understand those enabling and constraining institutions, I use Scott's classification of institutions with the technological element as expanded in this thesis (see section 7.1.1.). Inspired by Jepperson's (1991) processes of institutional change, I view institutional change as a two staged process of deinstitutionalization and reinstitutionalization that is constituted by small scale nonlinear transitions from the "as is" to "to be" institutional context. In line with such a view, HIS standardization is a shift from a non-productive HIS pattern to a more productive one using a continuous approach and following both bottom-up and top-down approaches.

Transition from "as-is" to "to-be" institutional context

HIS standardization involves various processes and issues, a primary one concerning the creation of a standard dataset, data warehouse and data collection procedures. The data warehouse will serve as one point of data entry and report generation in contrast to the existing systems. The existing system is characterized by a multitude of fragmented and vertical information flows, ceremonial value of health data, poor expectation of HIS and poor regulatory HIS institutions. The plethora of information sources that serve different stakeholders are deeply institutionalized. They do not share data even though the technical possibilities of linking them exist, especially with contemporary advances in ICTs. This then requires change in the value, perception, and norms of

the existing HIS in health organizations so as to build another legitimate value to health data, and cultivate a culture of data sharing. This is one layer. This is about data and procedural HIS standards. There is another layer, which is about supporting the HIS with a standard electronic tool, as the existing one is manual and ineffective to make data analysis. There are sets of norms, expectations, and shared assumptions contrasting or similar to the choice of electronic tool. This then requires specific change processes that are targeted towards addressing institutional aspects with respect to the preferred technological solutions. In practice, these layers and aspects are intertwined, and they are noticed during resistance or failure of standardization. Particularly, standardization is a transition from one aspect of standard to a new one and the resistance or acceptance is contingent upon the degree of the alignment of the standard to the specific institutions. The following figure shows the institutional gap that needs closure in standardization.

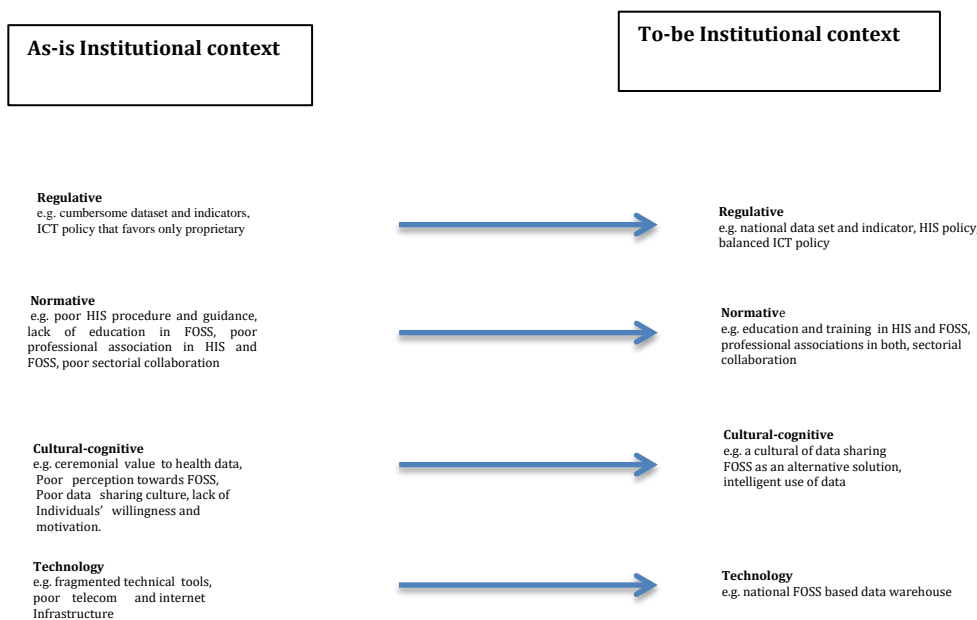


Figure 7-1 Standardization as transition from one institutional context to another (taking into consideration the Ethiopian HIS institutional context)

Forming standards that have regulatory power is changing these institutional aspects in an incremental and disruptive way. This involves institutional work to negotiate with the opposite norms, perceptions, rules and existing legacy institutions. As Slager, et al. (2012) argue, “regulatory power of standards does not appear out of nowhere, but results from the institutional work undertaken by various actors” (p. 764). To this end, the role of change agents (the institutional entrepreneurs) with their respective institutional forces comes at the center of standardization.

When the force is exogenous, institutional entrepreneurs need different sources of legitimacy to break open the different taken-for-granted assumptions that constitute the institutional “black box”

and dislodge established institutions in the technological field” (Garud & Kumaraswamy, 2002; Narayanan & Chen, 2012). The source of legitimacy can be norms of community of practice as discussed by Sanholtz(2012). The conflict of logics can also be a necessary step towards reaching an agreed upon standard. In addition, in case of the technological context, the nature of the technology and its interplay with the existing institutional context play a role in adoption and diffusion. In short, standardization is the result of the interplay of three institutional contexts.

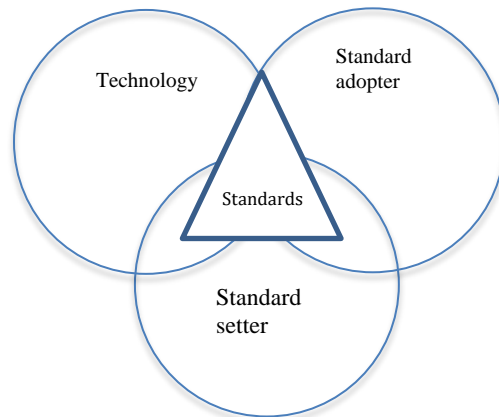


Figure 7-2: Interplay of three institutional contexts for HIS standardization

Project continuity as an approach

Taking an institutional perspective on standardization, we recognize the persistence of institutions to change processes. I suggest a continuity approach to overcome such rigidity. The following model recognizes institutional change to be a long- term process, which may be a contrast to the short-term of HIS reform efforts in developing countries. Such efforts are often project oriented and they tend to neglect previous efforts. A conscious act of changing institutions requires learning what margin of the institution changed previously and initiate new change based upon what has been previously achieved. For example, the study demonstrates, while it is easier to introduce a data warehouse, it is important to reconcile the different logics regarding the value of health data through time. Such values are embedded in the information sharing culture of the various stakeholders. Looking at the different dimensions of standards and changing what is possible with the given resources and commitment is a first step towards institutional change. This is especially important in order to overlap the gap between formal and informal institutions and to reconcile conflicting institutional logics. A legitimate actor who coordinates continuity is imperative for the practical implementation of the model.

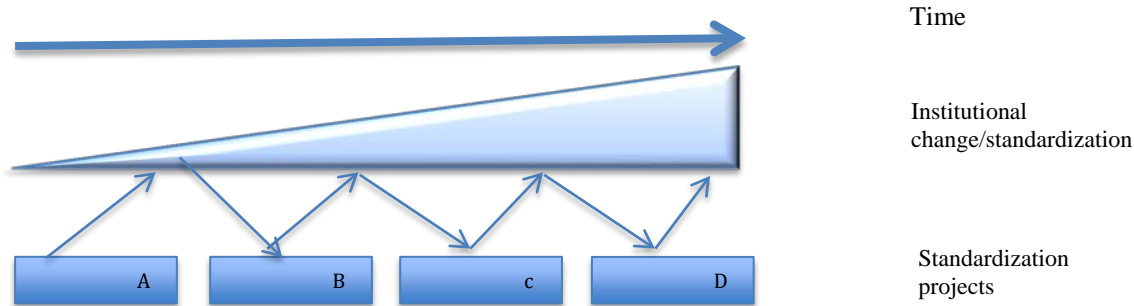


Figure 7-3: A conceptual model for project continuity as an approach for institutional change

In summary, in this section I presented one of the theoretical contributions of the thesis, which is an institutional perspective of standardization. I argued in the introduction chapter that our knowledge of how standards are formed and diffused is incomplete as such a process cannot be fully understood with only economic analysis and focusing on technical standards. To fill this knowledge gap I conceptualized standardization as institutional change. Such a conceptualization recognizes standardization as a transition from “as is” to “to be” having project continuity as an approach.

7.1.3 Temporality and multidimensionality of standardization failures

The institutional perspective I took in this thesis also contributes to our understanding of what we mean by failure in health information system improvement activities, in which standardization is central. As the institution literature insists, institutions can be persistent and they form inertia to change processes that standardization inevitably presupposes. Hence, things that can be thought of as failure at one point can be a success at another time or another geographic location. However, failure, in standardization at least in the HISP case I studied does not seem to be path dependent. As failure in Ethiopia and other countries have not been reflected in new initiatives in other countries; leaving the success and failure to rather be dependent on the strength of the local team.

This work particularly adds to the work of Rolland (2014) who shifts our understanding of failure in electronic information systems implementation from one of system centric to that of multidimensional and temporal. Recognizing the interconnectedness of infrastructure development, Rolland argues infrastructure improvement can fail 1) when trying to combine, replace and extend the new element with the installed base or 2) it can fail temporally and it is dependent on the various stakeholders’ perceptions of success and failure. In the same vein, this study identifies standardization as a multilayered long-term process and that failure could be in one element of the standardization such as the HIS work procedures. The case of Tajikistan shows, although change in the institutions of datasets could not be achieved, a change in creating a uniform electronic data warehouse was agreed upon. Change in the dataset was achieved after years of continuous effort. In Ethiopia, although there was a failure in diffusing the standard, it was possible to continue on

HIS related capacity building activities. This simply means that while durability continues in one element of the standard, forming of new institutions was possible on the other element and that there is no such thing as complete failure.

7.2 Practical contributions

7.2.1 Implications to practice

The practical implications are presented in three sets in the following paragraphs. The first implication is regarding formation and diffusion of HIS standards. The second practical implication is about how to evolve the standards so as to accommodate change over time. The third practical implication is concerning inter-sectorial collaboration for data generation and exchange.

During formation of standards there is a need to identify the enabling and constraining institutions looking at the different institutional aspects and dimensions of standards as discussed above. While changing the regulative aspect involves consensus among stakeholders, changing normative and cultural institutions requires various capacity building activities. Capacity building efforts should particularly focus on cultivating a culture of data sharing and building value to data, which is more than satisfying the bureaucracy. Assessing the perception, awareness and knowledge of various stakeholders regarding standardization and the electronic tools that need to be used could give a better possibility to knowing the institutional logics of the involved stakeholders. Therefore, a precondition for standardization could be a first level KAP (Knowledge, Attitude and Perceptions) assessment of stakeholders. In addition, as standardization is a cooperative activity, the thesis implies the need for building networks of stakeholders that are not necessarily co-located but willing to cooperate in standard formations. The network may give a sense of trust, continuity, shared vision, and formalization of standardization. It may also make it attractive for new stakeholders to enter the standardization arena. Moreover, the standards need to be flexible to accommodate new needs. I mean this in relation to program managers as well. Most of the efforts in standardization seem focused on district managers marginalizing and looking at the health program managers as hindrance to standardized and integrated HIS. That kind of view needs to be changed as they are at the heart of designing data to make it meaningful to monitor and evaluate performances.

Given the infrastructural imbalance within the developing country context, standardization needs to focus on data allowing the use of varying electronic and paper tools that fit the context. This is taking into consideration the current limited digitization of public services in developing countries. However, the study argues in favor of a uniform electronic tool for a functional area such as for monitoring and evaluation, patient record system, laboratory, etc. and facilitating data exchange

among these functional areas. The study also favors the use of state-of-the-art technology in developing countries as this is a driver to institutional context change.

Taking an institutional perspective, we recognize the fact that institutions can be persistent and there is a need for incremental change processes. However, HIS strengthening efforts having standardization as a salient challenge are often short-term and donor driven. They often ignore the prior work done by other stakeholders. The project continuity approach for institutional change informs practitioners in this area to build on prior standardization efforts by assessing and identifying the standardization dimension that was changed previously. To this end, there is a need for establishing a data management and use unit at the national level, which governs and becomes accountable for maintaining the standards and the network of stakeholders. As of now, as stated above, public sectors in developing countries are not as overloaded as the public sectors of the developed world with multiplicity of digital technologies that are not integrated and standardized. Therefore, such a unit can be instrumental in managing the evolution of such technologies and also determining which unit or stakeholders should be responsible for which type of data set.

The final implication to practice is regarding the need for inter-sectorial collaboration. Institutions are supra-organizations and their influence goes beyond one sector. However, sectors such as health, education, information and communication collaborate little on issues of data sharing, training and ICT related matters. The fourth paper investigated an example of such lack of sectorial collaboration. In order for FOSS products to be an alternative standard technical solution in the health sector, there was a need for creating a normative institution for FOSS in the education sector, and supporting it with ICT policy, which is the task of the information and communication sectors. In addition, there are other forms of data, such as population and vital registration that need to feed the health data standard. Hence, the last practical implication of taking an institutional perspective on standardization is to inform practitioners to go beyond the current compartmentalized sectorial approach to one that is inclusive of other sectors.

7.2.2 Implications to the health information system program (HISP)

The four cases in this thesis and other research outputs in the program have shown that data standardization produces a “maximum data set” as opposed to the sought “minimum data set”. Therefore, learning from the development processes of the DHIS as a generic software, I recommend data standardization to target a “generic dataset” that is more flexible than minimum as minimum implies that the ultimate goal is data element reduction rather than finding what is relevant and common to the involved stakeholders.

In addition, there is a need to recognize that the HIS in developing countries is centralized and the bottom-up approach that is rooted in Scandinavian tradition is not viable, particularly for data and procedural standards. Therefore, there is a need to target the MOHs or other national organs for such initiative if the HIS improvement is to bring about an optimal result.

The other implication is regarding the clash of HISP logic and the logic of the health organizations. One way of resolving this is including action research and participatory design in the training programs of HISP. There is a need to focus equally on the health, the action research, and the software aspect as all of these influence the outcomes of the HIS improvement activities. In addition, efforts should be made to include such courses in the curriculum of HIS related courses in the higher education of developing countries if it is thought to be a viable approach to software design. This may in turn contribute in disseminating an action research practice that may bridge the current gap in academics and practice.

In addition, as a fringe outcome of my review on procedural standards, I recommend a new practice in HISP to conduct meta-analysis of the action research outputs and produce “best practice” knowledge in the area of HIS that can be used as a protocol by national ministries. As of now, although there are several research outputs, they have not been summarized in a systematic way to understand HIS trends in developing countries and identify knowledge gap in the domain area. There is also a lack of longitudinal perspective to explore institutional change over time despite the stable but expanding network it is functioning on. This, I think, needs the due attention of HISP as it is a professional institution that has grown inside an academic setting.

The other aspect that may need attention to continue making DHIS evolve as de facto standard is to remain more generic on the functional side, meaning Monitoring and Evaluation, rather than being specifically on health. This is because there are some particularities across organizations on M & E than just on health that needs to be addressed in a generic way. This implication can also be taken for other types of technical standard evolution.

7.2.3 Implication to diffusion of innovation

The findings that indicate a bottom-up approach and de facto kind of standard evolution are not viable in developing countries have implication to innovation diffusion. It appears to be discouraging for individuals and lower level organization units to be innovative. It implies innovation/emergence of new tool of practice to only be the job of the higher-level authorities, ignoring the majority of the population. This has negative consequences for development projects. Therefore, there is a need for institutional change to foster innovation and enable bottom-up diffusion of innovation that may take the path of network effects.

7.3 Conclusions and implications to future research

7.3.1 Conclusions

This thesis was aimed at improving our understanding of standardization within the domain of HIS by exploring institution related influences on the process. The study was conducted as multiple case studies in three-research settings; Ethiopia, India and Tajikistan with the Health Information System Program (HISP). HISP is a professional network, which is engaged in health information systems strengthening activities in developing countries. The network is particularly engaged in capacity building, open source software development, and action research.

I explored how health organizations responded to the views of HISP on standardizing the various aspects of the HIS. Even though there are no specific guidelines regarding how to organize the HIS within HISP, the main principles such as participatory action research, minimum dataset, hierarchy of standards, and open source software have been tried in many settings, including the research settings for this thesis. Those principles are anchored within the Scandinavian tradition of participatory bottom-up system design and development. The outcomes of the standardization in the four cases cannot be seen in isolation from the traditions of HISP and the hierarchical, centralized and top-down institutional arrangement of the health care organization. Those are in fact in direct contrast to each other. The institutional arrangements on both sides exhibit path dependency that emanated from past politics (e.g., the case of Tajikistan) and success story (HISP's success in South Africa), which are taken-for-granted as to their relevance. I specifically studied how the health organizations responded to such kind of professional group initiated change processes. The health organizations responded by resisting the whole standards (Ethiopia at national level), accepting one form of the standard (India) or negotiating the standards (Tajikistan). However, the outcome has been seen to be changing through time making us realize failure in information systems as a temporal phenomenon.

The result of the study shows that there are multiple institutional logics that stem from the different historical bases of HISP and the health organizations that need to be recognized and negotiated taking long-term perspectives. For that there is a need to broaden our conceptualization of standards and standardization within the public sector. First, the dominant view on network effects as a perspective on standard evolution needs to be complemented with other institutional mechanisms such as regulative, normative and mimetic that gives legitimacy to the standard formation and evolution. In two of the cases of this research, network effects have not been seen to contribute to gaining legitimacy to further diffuse standards that had already been used by many sub-organizations. Hence, the study suggests conceptualizing standardization as institutional change as there are multiple entrenched institutions, such as shared assumptions, norms, values and formal rules, which need to be changed to come to a consensus. Second, after gaining legitimacy,

there are informal constraints that need to be addressed to diffuse the standard within the health hierarchies.

The conceptualization put forward institutional change to be both radical and incremental and that was achieved through a long-term perspective by building on previous project results. Building underlying social capital that is composed of formal and informal relationships is found to resolve some of the institutional challenges such as capacity and to stimulate change process. In addition, such relationships with the main tenets of trust and reputation are found to help diffuse technological standards. The social capital concept is consistent with the economic perspective except it highlights the positive role of informal relationships in standardization efforts. This implies that the economic and institutional perspectives are not mutually exclusive but complement each other by deliberating standardization issues from different perspectives.

The research provided practical implications that stem from the research findings and review of related studies to both HISP and health organizations.

7.3.2 Further research

While doing this research, I found two research topics needing further exploration to deepen our understanding of institutional influences on standardization. The first one is a call for a more nuanced multilevel qualitative analysis on the role of “institutional distance” that may highlight the difference in institutional elements within and across countries on standard institutionalization. Institutional distance is distance between “standard originators” and “standard adopters” and it can be qualitatively measured using institutional elements –rules and regulation, norms and cultural-cognitive (Xu and Shenkar, 2002). This would be an extension of what I explored in Paper IV. As stated above, this may have implication for devising institution sensitive IT/HMIS policy and strategies that facilitates adoption and diffusion of standards in many settings. I believe HISP can be a good arena for conducting such a study.

The other study that I think needs further researching is the notion of information culture. HIS researchers repeatedly pointed out the poor use of information in developing countries. Now it has almost been two decades since the agenda got the attention of international and national health reformers. The institutional elements in various countries changed through time as a result of political, functional, social and technological pressures. Therefore, there may be a need to examine if we are still continuing the same argument without critically investigating the current situation or if we are circulating myths. Therefore, a further study could examine the culture aspect of information as hindrance and/or enabler for implementing formal institutions and hence assess the formal-informal institutional gap after two decades of institutional development for HIS. It can particularly focus on studying the information seeking behavior of district managers. I recommend a shift of focus from cultivating a data use culture to information sharing culture. This means looking at information as infrastructure that is sharable.

In general, there is still a need to study standardization in the health care sector particularly related to data standardization. The area has not received enough research attention despite being at the core of integration and data quality improvement.

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Appendices

Paper I: Mekonnen, Selamawit Molla, and Sundeep Sahay. "An institutional analysis on the dynamics of the interaction between standardizing and scaling processes: a case study from Ethiopia." European Journal of Information Systems 17.3 (2008): 279-289.

Paper II: Sahay, Sundeep, Johan Sæbø, Selamawit Mekonnen and Abyot Gizaw. "Interplay of institutional logics and implications for deinstitutionalization: case study of HMIS implementation in Tajikistan." Information Technologies & International Development 6.3 (2010): pp19-32.

Paper III: Mekonnen, Selamawit Molla, Sundeep Sahay, and John Lewis. "Understanding the Role of Social Capital in Integrating Health Information Systems." Journal of Health Informatics in Developing Countries 9.2 (2015).

Paper IV: Mekonnen, Selamawit Molla, and Zegaye Seifu Wubishet. "An Institutional Perspective to Understand FOSS Adoption in Public Sectors: Case Studies in Ethiopia and India." American Journal of Information Systems 4.2 (2016): 32-44.

Paper I



An institutional analysis on the dynamics of the interaction between standardizing and scaling processes: a case study from Ethiopia

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Abstract

This paper presents an institutional theory-inspired analysis of the dynamics of interaction between processes of standardizing and scaling, in the context of Health Information Systems implementation in the Ethiopian public health care system. Standardizing and scaling have, in existing research, been treated primarily as independent technical processes that are isolated from the institutional context in which they take place. This paper tries to redress this balance in this research in two ways. Firstly, it argues for these processes to be taken as inter-related which can both support and undermine each other. Secondly, this mutual interaction is argued to be mediated by the institutional context. Specifically, we draw upon concepts from institutional theory inspired by Douglas North, focusing on the degree of overlap between formal institutions (attempts to establish formal policy on activities such as the definition of indicators and uniform reporting formats) and informal constraints in practice reflected in inadequate capacity – both technological and human, and existing work practices.

European Journal of Information Systems (2008) 17, 279–289. doi:10.1057/ejis.2008.17

Keywords: Health Information Systems; institutional theory; scaling; standardizing

Introduction

Routine Health Information Systems (HIS) in the context of developing countries are concerned with the collection, processing, analysis, transmission and use of data on a periodic (daily, monthly or annually for example) basis by staff in the health sector. The health sector is responsible for the implementation of various health programs including the administrative tasks of reporting. What data are collected, how they are reported, who receives them, and how they are used, are decisions taken by the various program managers in conjunction with the national and state ministries of health. There can also be international policies such as the European Union directives on HIS (Allaert & Barber, 1998). These directives and decisions represent formal institutions (e.g. policies on reporting formats and data standards), which the health staff on the ground are expected to comply with. However, as research has pointed out (e.g. Piotti *et al.*, 2006; Kimaro & Sahay, 2007), how these formal institutions play out in practice are shaped by various informal institutions such as the existing work practices, resource constraints and staff capacity. There is thus an ongoing interplay of formal institutions and informal constraints, which shapes various processes around the HIS. In this paper, we focus specifically on the

Received: 28 February 2007
Revised: 10 August 2007
2nd Revision: 4 May 2008
3rd Revision: 12 June 2008
Accepted: 13 June 2008

analysis of processes around standardizing and scaling of HIS within a developing country setting.

Standardizing and scaling are among the most salient challenges confronting the implementation and effective use of HIS in developing countries (Braa *et al.*, 2004). Standards specify working characteristics (Hanseth *et al.*, 1996) and are fundamentally necessary for HIS to work effectively. Standards are 'measures established by authority, customs, or general consent to be used as point of reference... a standard specifies how we work, how our technologies interact and holds the socio technical societies together' (Timmerman & Berg, 2003, p. 24). Bowker & Star (1999) argue that standards are intended to make heterogeneous things work together over distance, for example, computer protocols for internet communication that involves a cascade of standards that need to work with each other to provide accessibility to the web (Bowker & Star, 1999). In the context of HIS in developing countries, Mekonnen & Lagebo (2005) have described standards to encompass three aspects: uniform definitions of data elements, uniform reporting formats and similarity of working practices (e.g. of reporting frequency).

Scaling, in general terms, refers to the expansion of the scope of a system either geographically or in its functionality. In the context of HIS, scaling involves the expansion of an artifact, a system, 'best practices' or procedures from a certain point of its origin to both vertical levels (e.g. from the facility to district to province and national levels) and horizontal levels (e.g. from one district or health program to another) (Sahay & Walsham, 2006). Sahay and Walsham describe scaling as a socio-technical process that is more than about numbers and geographical areas, and involves the escalation of complexity.

Standardizing and scaling are inextricably related. For example, to calculate the immunization coverage for a province, similar data (as per defined standards of data definitions) need to be collected from all the health facilities in that province – that is full scale. Without this full-scale coverage, data collected from isolated facilities are of marginal use to the decision makers who need an overview of the whole region. Further, full scale cannot be achieved if uniform standards are not adopted by all the facilities. Full scale involves various components including the technical systems (e.g. a database with the capacity to host the entire data for the region), staff with the capacity to understand the prescribed standards – what data should be collected, when and how, and a uniform political will to implement standards at full scale.

Despite the inextricable link between scaling and standardizing, prior research has tended to examine these processes independently (e.g. Sahay & Walsham, 2006). There is an implicit assumption often made that standards will contribute to scaling and vice versa, which empirically has been refuted by some studies (Mekonnen & Lagebo, 2005). A key argument made in this paper is

that these processes must be analyzed in conjunction as one can both support and/or undermine the other. Understanding why and how this happens is a key focus of this paper. The theoretical perspective is drawn from institutional theory, since scaling and standardizing are primarily institutional products, and shaped by the institutional context in which they unfold. Prior research has not explicitly analyzed how the institutional context (both formal and informal) shapes these processes. Within this backdrop, the research aims of the paper are twofold:

1. What is the nature of the interplay between the processes of standardizing and scaling within the context of HIS in developing countries?
2. How does the institutional context mediate this interplay? And how does this shape the implementation of HIS in developing countries?

Answering these research questions arguably provides a significant contribution to IS research where the relation between standards, scaling and institutions has not been explored in any depth by prior research.

The rest of the paper is organized as follows. In the next section, we discuss some theoretical concepts underpinning our analysis. This is followed by a description of the methodology and then the case study. We then present the case study analysis followed by some brief conclusions.

Theoretical perspective: informed by institutional theory

David North (1990), a celebrated economist, uses the metaphor of a game to make the important distinction between organizations and institutions. He writes: 'if institutions are the rules of the game, organizations are the players' (p. 3). In the context of our analysis, standards can be seen as the rules of the game established by the Federal Ministry of Health, which the health services department will play within the context of performing their HIS-related activities. These rules can be in various forms, both formal and informal. Formal institutions can be in the form of policy statements, laws, constitutions, etc., while informal constraints concern norms of behavior and self-imposed rules of conduct (North, 1990). In our case, formal institutions could include an HIS policy that defines health indicators, the periodicity and formats for their reporting, and by whom. If all the players involved play with the same rules, expectedly, larger scales will be achieved. However, as Mavimbe & Bjune (2007), who studied the implementation of standards related to the Expanded Program of Immunization in Mozambique, have argued, this is not always the case, and standards are adopted quite differently in local contexts due to the variations in resources, capacity, knowledge (geographical and political), distance between the periphery and the center, and the political will. This institutional and socio-cultural

context thus arguably mediates the interplay between processes of scaling and standardizing.

Another concept from institutional theory relevant to our analysis concerns that of an 'organizational field' (DiMaggio & Powell, 1991). Avgerou (2002) describes an organizational field to be constituted by 'organizational actors competing in the production of similar products or services... consumers and regulatory agents' (p. 38). In an organizational field, there may be a principal actor who may or may not be geographically co-located, and who takes on a lead role by regulating technical exchanges and financial transactions. They also seek to establish cognitive influences and contractual regulations to ensure that the actors follow the rules. The concept of organizational field emphasizes the multiplicity of organizations that jointly influence the establishment and implementation of institutions (in our case, HIS-related standards). For example, in Kerala, India, the state government has established an Information and Communications Technology (ICT) policy which promotes the use of Free and Open Source Software (FOSS) for the public sector, including health. The state government thus becomes an important actor in the organizational field. Others in this field could include the province or regional authorities, donor agencies, hardware and software vendors, and civil society entities like the media. An institutional analysis will seek to understand the nature of influences that these multiple entities bring to the table, including various institutions and the mechanisms for their enforcement. For example, the Kerala ICT policy recommends 'to use FOSS to the extent possible,' which implies the mechanisms for enforcement may be rather ambiguous and informal. In other cases, the Ministry of Health may have the power to cut off resources to those provinces not using FOSS, implying a stronger enforcement. Regulation can come in various forms ranging from cognitive influences (meanings of what is right or wrong) to contractual incentives or disincentives in adopting institutions or not.

Another concept from institutional theory that is relevant to our analysis concerns the degree of overlap or not, between the formal institutions and informal constraints. Drawing upon this analytical notion, Piotti *et al.* (2006) argue that the effective introduction of new HIS-related reforms in Mozambique require the maximization of the overlap between formal institutions and informal constraints. For example, they describe how the Mozambique National Health Service formally established institutions by mandating the calculation of integrated indicators cutting across health programs. However, informally there is a historically existing compartmentalized style of working of health programs, which made it difficult to share information, leave aside jointly calculating and discussing health indicators. They argue that the poor overlap between the formal and informal contributes to challenges in introducing reforms and if such overlaps can be increased, for example through the more active involvement of the end users in

the process of indicator definition, the probability of success will be enhanced.

A majority of prior studies in IS research drawing upon institutional theory has focussed on an understanding process of organizational persistence rather than change. An early application of this theory in IS was carried out by Kling & Iacono (1989), who used it to explain the failure of the adoption of a Material Requirement Planning. Among others, one of the reasons identified for this was that the actors involved were used to a certain way of doing things (e.g. working with a system based on RPG II) and found it difficult to changeover to the new system developed using BASIC. A more recent work of Noir & Walsham (2007) also used institutional theory to explain the theme of persistence in the context of ICT implementation in the Indian health care sector. The authors emphasized the mythical and ceremonial roles that 'ICT for development' played in legitimizing development initiatives. For example, the ICT implementation for collecting and reporting health data were carried out only '...as prescribed by the government, not so much for the technical purpose of the reports (to supply actionable data) but so that health facilities could conform, albeit ceremoniously, to institutional government rules' (Noir & Walsham, 2007, p. 19).

In contrast to the above studies, our research seeks to understand how the institutional context mediates processes of change, specifically related to the processes of standardizing, scaling and their interaction effects. Institutional theory provides us with a set of concepts to help analyze the conditions and mechanisms that mediate the relationship between processes of standardizing and scaling. Such an analysis will in turn help to shed light on why this relationship is not as straightforward and linear as is often assumed.

Research approach

This research is part of the University of Oslo's Health Information System Program (HISP) initiative ongoing in various developing countries, starting in South Africa in 1994. HISP is bathed in an action research tradition where the aim is to make improvements in the HIS, including cultivating the use of information at the origin of its generation. Action research has two main components: action and research (Carr & Kemmis, 1986; Baskerville, 1997). Being part of the action research project in Ethiopia, the key foci of our interventions were around the development of standards in the HIS (including data definitions, reporting formats and work practices), and scaling them to other facilities within the region and also to other regions. This project was carried out collaboratively with the regional health bureau of Addis Ababa, whose managers had previously identified the lack of standards and limited use of information to be key impediments to the implementation and use of effective HIS.

In the diagnosis phase of the research, we conducted a situation analysis to understand the specific nature of the

Table 1 Summary of data collection methods

<i>Data collection methods</i>	<i>Description</i>														
Interviews	<table border="0"> <tr> <td>Level</td> <td>Number of respondents</td> </tr> <tr> <td>Hospital</td> <td>5 (Statisticians and health program experts)</td> </tr> <tr> <td>Health centre</td> <td>24 (Statisticians and health program experts)</td> </tr> <tr> <td>Health post</td> <td>2 (Nurses, health officers)</td> </tr> <tr> <td>Sub-city</td> <td>10 (Program managers)</td> </tr> <tr> <td>Region</td> <td>5 (Statisticians and health program managers, region health bureau head)</td> </tr> <tr> <td>National</td> <td>1 (HMIS team leader)</td> </tr> </table>	Level	Number of respondents	Hospital	5 (Statisticians and health program experts)	Health centre	24 (Statisticians and health program experts)	Health post	2 (Nurses, health officers)	Sub-city	10 (Program managers)	Region	5 (Statisticians and health program managers, region health bureau head)	National	1 (HMIS team leader)
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Observations	Participant observation in the field sites where we implemented the district health information software and during trainings, workshops and meetings. We also employed observation to understand the existing situation.														
Document analysis	Documents such as strategic plans, reporting formats, health data of the health department as well as literature related to our study were analyzed.														

challenges experienced such as the lack of uniform definitions of data and formats in various health facilities, which meant that planners did not receive effective information support from the HIS. This situation analysis followed a period of introducing various interventions to firstly create standards through mechanisms such as workshops and meetings, and then their gradual scaling to other facilities. Capacity building was central to our efforts, in building awareness among the staff about the changes made and how the new systems could be used. Evaluation was done both informally (in discussions) and formally (research papers and thesis) which helped to identify the improvements made, and also what remained to be done.

Practically, within this overall action research approach, fieldwork (situation analysis and action interventions) was conducted within the regional bureau of Addis Ababa region of Ethiopia from July 2003 to August 2005. The fieldwork encompassed multiple levels of the health care system, from the lowest level of the health posts up to the sub-cities and the regional level. Also, a variety of types of health facilities such as hospitals, health facilities and health posts were included as our interest was to enable the establishment of a full-scale regional database. Various qualitative data collection methods were employed including interviews, observations and document analysis (see Table 1 for an overall summary).

The aim of our data collection was to primarily understand from the respondent's perspective on what were the kinds of problems experienced, especially relating to standards and scale; how they were trying to address them; and how could our interventions help in this regard. The multi-level and longitudinal research design helped us to understand both the formal institutions that the federal and regional levels were trying to prescribe, and the challenges (arising from the local constraints) in them being adopted by the field staff. A number of participatory workshops were also conducted

to get the different stakeholders together, understand the problems they experienced and to jointly identify solutions. Various training seminars were conducted to build awareness about the new standards developed, and to support their gradual introduction into the routine HIS.

Data analysis was carried out within an interpretive tradition (Walsham, 1993) where various analytical themes were identified (e.g. around the four facets of standards – data definitions, formats, software and work practices), the challenges experienced under each of these areas, and their interlinkages. This helped to gradually develop an integrated analysis around the issue of standards. Similar was the case with scaling, where geographical and functional scaling were identified as being key facets. At the next and higher level of analysis, we analyzed the interplay between the two sets of processes, and the mediating role of the institutional context.

Case narrative

This case narrative is described in two main parts including the situation analysis and the action interventions made, both focussed around the processes of standardizing and scaling.

Analysis of existing situation

The health structure in Ethiopia is organized at four main levels: the sub-district level of the health facilities, which serves as the first point of contact between the community and the health services; the level of the district called sub-city in Addis Ababa Region, which serves as the hub for HMIS activities; the province (region) level, which compiles all data on the districts in it; and finally, the national level.

Data collection at the health facility comprises several processes and procedures, including those for data generation, recording and compilation; and involves the use of various artifacts such as books, registers,

diaries, forms and in some cases computers. In terms of staffing, the health facility has an institutional position of a statistician responsible for the collection of data from the outpatient and inpatient departments (called Morbidity and Mortality – MM). However, we found the statistician post to be vacant in most of the facilities we visited, and non-qualified people were temporarily occupying the position. A family health expert said:

Most of the ‘statisticians’ are neither statisticians nor medical persons. Therefore, the probability of making errors while counting cases from the registers is high. For example, one time, I got extremely low number of antenatal visits from the hospitals and I made the nurses responsible for that work, to count it again. I got significant differences. It is impossible to trust the quality of data.

The problem of inadequate educational capacity was further magnified by the absence of systematic capacity building programs, contributing to the poor quality of data. For example, we found a new member at the statistics office, collecting the same HIV/AIDS data from two registers. When asked about it, she said:

I did not know before that these two registers contain the same data. When the person left the job, they asked me to work on his position and I agreed thinking that it is better than what I was doing before. But, when I started the work, I found it very confusing. I do not have any one to ask, to clear out my confusions. Therefore, I am learning by trial and error.

Many statisticians we interviewed also expressed dissatisfaction over their salary conditions, for example, one of them at a health centre said:

I have been doing this kind of statistical work for ten years but my salary is only 400 birr (about USD 40). No one considers me as useful... I like the job but I’m very much discouraged by the salary, if I can get another job I will not hesitate to leave this one.

Each department of the health facility was responsible for maintaining records of all cases (of health services provision) using primary data collection tools like registration books, tally sheets, forms and patient or client cards. Data collected through these tools served as sources for the secondary data collection tools (monthly reporting formats). Except for the case of MM data, all monthly reports were compiled by ‘health experts,’ who unlike the statisticians had received some formal training. The collection and compilation of the daily MM data was the responsibility of the statisticians. However, in the absence of standardized data collection procedures, the statisticians collected the raw data from registers, while in other cases the health workers collected these data and submitted them to the statistician for reporting. There was thus a degree of ambiguity between the boundaries of the responsibilities and between the statisticians and health workers, which often contributed to missing or data being counted twice. Some health programs, such as the Integrated Disease Surveillance Reports (IDSR), did

not have specific data collection instruments, and different facilities created their own local formats. This lack of consistency in formats and also what was collected contributed to poor quality of data.

At the district level, reports were received from the health facilities on a monthly, quarterly or annual basis, as per guidelines specified at the federal level. In addition, quarterly reports were also made for the District Capacity Building Department in their specified departmental formats that were different from those used for the Health Department. Since the Capacity Building Department was responsible for the allocation of resources to the health department, reports to them assumed a degree of importance, requiring health workers to prepare two sets of reports from the same data but in different formats.

At the province level, district-level reports were received by the health experts in the Family Health and Disease Prevention and Control Departments. They in turn compiled multiple copies of all the received reports, had them signed by the team leader, retained one copy and sent the remaining to various entities including the respective health program team/experts at the national level, the Plan and Program Department at the MOH (responsible for the HMIS), and to international agencies such as the WHO and UNICEF. While a number of computers were present at the province level, they ran specific programs either for TB, malaria or leprosy. These systems did not speak to each other and had their own individual reporting formats, making it difficult to create uniform formats. How well resourced individual health programs were, shaped the degree of training the staff received, which created variability in the implementation of HIS-related procedures and practices.

At the province level, the flow of information from the hospitals was also not standardized, with only three of the five hospitals reporting their data regularly. Furthermore, these data were sent to different departments and in non-standard formats. Data collection procedures also varied with hospitals, for example the International Classification of Diseases (ICD) code was in some cases entered and in others ignored. Sometimes this code was written on the patient card and at other times in the inpatient registration book. Often, the statistician picked the primary diagnosis and assigned the ICD code by herself, which led to errors since the statistician did not have the requisite medical background to do so.

In summary, the situation analysis helped us identify various problems related to both standardization and scaling. We found the use of non-uniform data items, varying work practices, non-standard reporting formats, and the absence of a comprehensive HIS software to be some of the serious impediments existing. There were also issues of scale, for example the lack of skilled manpower and equipment at all facilities prevented the uniform spread of systems to all facilities. How we tried to deal with these various challenges is discussed in the next section.

Action interventions around standardization and scaling efforts

Our efforts were focused on the following four sets of activities: developing a minimum essential provincial data set; defining uniform primary and secondary data collection instruments; customization of a standard software application that could implement the required data sets and reporting formats; and creating standard working procedures for carrying out the various HIS activities.

Data sets Through the paper formats we first identified all the data elements and consolidated them, producing a list of 1202 data elements excluding the MM data. Including the 150 lists of diseases for MM reports, categorized by age and sex, produced more than 3609 data elements, making the regional data set very cumbersome. After defining the 'maximum' data sets (including all non-redundant data elements), we engaged in a process of indicator definition and 58 indicators (14 national and 44 regional) were defined in the database. Interestingly, we found that from the total of 3609 data elements, only 414 were used in the calculation of indicators, reflecting a HIS not geared for supporting action.

The standardization process in some cases contributed to decrease in the number of data elements, for example, the EPI data used to be collected by age categories (0–11 and 12–23 months), divisions that were subsequently eliminated. In other cases, the number of data elements was increased, for example three new categories were added to data on Tetanus vaccination (from TT1 and TT2+ to also include TT2, TT3, TT4 and TT5). The participants in the indicator definition workshops often seemed inclined to add more data elements, for example, a laboratory technician at the health facility said:

More items should be added. For example, ESR, WBC, D/F, Blood group, Haemoglobin should be included in the laboratory reporting format. It is not enough to summarise all these as 'others'. These are helpful for me while requesting for reagents.

Often, health workers argued that they needed to report in order to make their work visible to the higher-ups, and reducing elements could reflect the opposite. From our perspective, adding elements was based on the interests and opinions of users at all levels, which led to the compilation of a 'maximum data set.' While this was not the most optimal solution, it helped create a basis where all the actors could be brought to the table and engage in subsequent dialogue to agree on first minimum and then essential data sets. This process was, however, shaped by the institutional context of the Ethiopian health care structure, where decision making was relatively centralized and provinces had limited autonomy to bring in changes – especially in deletion of even non-essential elements. For example, even though most of the data collected by the IDSR and IMCI reporting formats were

included in the MM reporting format, it was not possible to remove the redundancies before taking approval at the national level.

While we were not able to bring out these changes, our process of standardizing helped in identifying and making these various duplications visible to the health managers, and agreeing upon the need for making changes. From the scaling perspective, the 'maximum data set' approach helped to cover all the vertical health programs. However, even if some of the data elements were not needed by any of the programs, as we could not scale vertically to the national level, it remained untouched. Furthermore, horizontal scaling (across programs) could not be practised without the formal endorsement of the national level program managers.

In 2005, another formal HIS reform process was initiated by the Federal Ministry through a global tender, which was subsequently awarded to an American agency. As a result, we were emphatically instructed by the national level to stop our processes of standardizing and scaling at the province level, as it would be in conflict with their process. Even the province authorities were reluctant to introduce any further changes in anticipation of the new formats and standards to be introduced through the federal reform process.

Reporting formats It was then required for the revised data sets to be reflected in the various levels of data collection and reporting instruments, such as patient cards, laboratory request forms, etc. Data once registered in its primary form needed to be compatible with and fed into the next level of instruments such as registers and tally sheets. For example, while registers and monthly reporting formats of laboratory services required patient 'sex' to be identified, the laboratory request form did not identify 'sex.' To make the report complete, the health workers filled in the 'sex' based on the name of the client or the patient. This raised problems, as a name in Ethiopia can serve for both sexes, for example, Meseret. The second level emphasized the need for compatibility of data items of the registers and tally sheets with the periodic reporting formats. For example, data elements that appeared on the 'antenatal service' monthly reporting also needed to appear on the 'antenatal' registers that provided all the data required (first, second, third, fourth + antenatal visits). In the third level, the emphasis was on creating consistency of data elements at the other levels. For example, all the data elements for antenatal service reporting format needed to be included in the computer system so that the required reports could be generated.

Uniform and comprehensive secondary data collection tools were produced as a result of the standardizing process. In some cases, a few primary data collection instruments were also designed, but not implemented during the course of our research due to various resource constraints. The new formats designed to address the lower level data collection formats, such as laboratory

request forms and patient cards, also helped to feed data into the registers. The standardization process enabled the scaling process of reporting formats down to the health facilities, since the lower level registers were made compatible with the reporting formats.

Software system After developing a revised version of the reporting format, the next step was to implement it using a comprehensive software application. We used the District Health Information Software (DHIS) as a starting point, which had been developed and used extensively in South Africa. There were both similarities and differences between the Ethiopian and South African health care systems, which needed to be adapted to the software requirement. A key difference concerned the use of the ICD code list in the Ethiopian health care system which was not used in South Africa. This was dealt with by designing the MM module and integrating it at the bottom of the already existing Monthly Data module of the DHIS. The organizational structure that had five levels in South Africa was adapted to accommodate the four-level organizational hierarchy in Addis. The data elements identified during the standardizing process were defined on the screens in a way to match with what was collected on the paper.

There were adaptations to be made because of the differences between the Ethiopian calendar and the Western one. For example, we adapted the TB module to fit the Ethiopian year, which is 7 years behind to that of the Gregorian one. Moreover, what is the first quarter in Ethiopia is the third quarter in South Africa. As additional requirements were highlighted, we tried to respond and provide those functionalities. However, some requests, like the development of additional modules for personnel and drugs, could not be built due to time constraints, and this restricted the functional scaling of the system.

The existing technical fragmentation, due to different health program experts having their own software systems, for example, MS Excel and Epi Info, impeded both the development of a uniform comprehensive HIS and its scaling to both horizontal and vertical levels. Since these fragmented systems historically served the interests of specific groups (such as different donors), there was little possibility to achieve an institutional integration to address all the health programs. Furthermore, as most of the health workers did not have basic computer skills nor a computer in their facility, scaling of a computerized HIS was inherently restricted. However, by taking measures such as the extending of the training program from 2 to 3 weeks, all the health facilities could be covered. This scaling was reinforced by the cooperation of the bureau management, who equipped each facility with a computer, leading to a full geographical scaling of the software system. The training programs were also sensitively designed to accommodate the varying educational backgrounds of the trainees, and

basic computer training was incorporated together with that on the HIS software (DHIS).

Work practices Owing to time constraints, our efforts towards developing standard work practices to support the HIS activities were rather limited. Redefining work practices required an institutional mandate, which we as researchers did not have, and neither were there adequate resources at the lower levels. The institutional conditions of poor salary and low motivation levels of the staff implied difficulties in introducing any form of changes. Given the initial stage of the implementation, and that both the paper-based and computerized systems were functioning in parallel, work practices were in a fluid state, and not easily subject to standardization. The computers were potentially introducing a significantly new way of working with HIS, which required a rather dramatic change in work attitudes. For example, when an MCH expert was asked why they processed data separately instead of using what had been prepared by the statisticians, he replied:

Even if the data collection and aggregation is additional and more time consuming for us, we are forced to do so from the RHB even though they know that double processing of data is being done. I want to use what is processed by the statistician to make our work easier, but cannot.

While staff at the lower levels were interested to work with the DHIS, as they believed it would reduce their workload, the health program experts at the provincial levels resisted the change and preferred to collect data for their own use. These non-standardized work practices adversely influenced the scaling of technical systems.

With the use of the DHIS, we unsuccessfully tried to create one comprehensive channel of information flow through the statistician at the sub-city. Contrary to our intentions, two flows of data emerged, one through the statistician, who used the DHIS to prepare all reports including ones for MM and diagnostic activities and sent a consolidated set to the Plan and Program Department. Prior to the introduction of the DHIS, this department only received the MM reports. However, other departments such as Family Health (including maternal and adolescent reproductive health, child health, EPI and family planning) and Disease Prevention and Control (including TB, leprosy and HIV/AIDS and surveillance) kept the *status quo* with reports being sent directly from the Centre for Disease Control team of the Sub-City Health Department (SHD), and sent consolidated reports to their respective program managers at the national level. The fragmentation of the information flow in the manual system was to some extent replicated in the DHIS because of the unchanged work practices. It was not possible to create a comprehensive flow of information due to the independent channels of information flowing directly to the SHDs. As a result, the statisticians at the provincial levels became responsible only for the MM data, which worked against the creation of

a comprehensive reporting system. In addition to the standardization of the data set and reporting formats, we needed to redefine and standardize the information flow and the associated work practices, an institutional mandate that was not available with us.

Analysis and discussion: institutional mediation of the processes of standardizing and scaling

The analysis will focus on two key issues: one, concerns how the institutional context mediates the relation between the processes of standardizing and scaling; and, two, the interaction between the processes of standardizing and scaling.

Institutional mediation of processes of scaling and standardizing

The key theoretical concept drawn upon from institutional theory concerns the degree of overlap between the formal institutions and the informal constraints. In Addis Ababa, our standardizing and scaling efforts were local, intensive and ongoing. The two researchers who worked in this region spent more than a year on these efforts, and had a very sound and grounded understanding of the local context, for example, they knew in minute detail what are the data elements gathered under different programs, who were responsible, and the informal work-arounds involved in the registration, reporting, analysis and transmission of data.

This detailed and micro-level understanding was complemented with strong political support from the bureau authorities, who showed a strong commitment to firstly standardize the data sets, formats and software, and also to scale them up to all the facilities in the region. This commitment was expressed in various ways. Firstly, they provided us with complete support including resources to conduct training programs, and urged their staff to actively participate in the process. Secondly, changes identified by us around standards were discussed and implemented whenever possible, so that results could be made visible to all. Thirdly, they provided computers to all the health facilities, so that the standardized elements and formats could be scaled to the complete region. The authorities understood that without full scale standards could not be implemented, and vice versa.

The micro-level knowledge of the informal processes, practices and constraints coupled with the top-level political support helped to ensure that the gaps between the formal institutions and informal constraints were minimized. For example, we understood very early on that while it would be relatively easy to develop standards around reporting formats and data definitions because the health staff needed to release some of their constraints (overload, collecting redundant data, etc.), it would be close to impossible to even start to standardize work practices.

Another example of our approach to minimize the gap between the formal and informal is reflected in how we

agreed to many of the suggestions made by the staff including the addition of new elements. This led to the creation of a 'maximum data set,' rather than a minimum data set as was our earlier goal. But we understood, the limited power to introduce change that the staff at the local levels had, and instead of shooting for something impossible, we agreed that we should create this maximum data set as a way to enrol all the stakeholders in the process. Once this basis of trust and understanding was established, we could try to move to the next level of the minimum and even further to an essential data set (linking all collected data with the calculation of indicators).

While the processes of standardizing and scaling worked reasonably successfully in our opinion, these processes came relatively to a standstill in the presence of the ongoing efforts of the Ministry of Health to create national standards. As mentioned earlier, an American agency, on official contract with the Ministry of Health, was simultaneously designing standards for indicators, reporting formats and data items. There were thus new influences on the HIS process with new actors entering the organizational field. This actor (the American agency), in creating new institutions at the national level, worked with a large gap as compared to the constraints that existed at the local level, which we believed could not be expected to be removed easily. For example, now the new reporting formats required groupings to be created based on types of health facilities (all health posts or sub-cities) rather than by facilities within a particular geographical area. The local facilities were largely unequipped to make this changeover as it required new formats to be prepared, training to be given, and more importantly, the health staff needed to forget their existing ways of doing work. This we argue is a non-trivial changeover, and will require better understanding by the implementation authorities of the informal practices and constraints. Just presenting new manuals to the health facilities, and expecting the changeover to un-problematically diffuse to the whole health system, is an assumption that has been seen to fail in various earlier ICT-based reform efforts. As Nhampossa (2005) has pointed out in the case of HIS in Mozambique, the diffusion approach is fraught with complex challenges, and instead a 'translation' approach is required which slowly and incrementally tries to bridge the gap between the formal institutions and informal constraints.

The interaction between the processes of scaling and standardizing

The research was initiated first in Addis, and through a participatory process, the standardization achieved in Addis facilitated the scaling both vertically (to all health facilities) and horizontally to other regions (e.g. of Benishangul-Gumuz). The Addis standards were taken as the point of departure, and sensitively adapted to other regions without completely having to reinvent the wheel.

However, starting with standards from one region for initiating scaling processes in other regions also came

with its own sets of challenges. The absence of standards on malaria and environmental health in Addis, for example, led to new processes of standards having to be created in the other regions, which in turn slowed down the scaling processes. Further, in Oromia region, because of the high incidence of malaria, there were specific requirements about collecting and reporting data about malaria. Malaria was not a problem in Addis, and thus malaria-related data elements were not a part of the existing data set. Similar was the case with some other data sets like for environmental health, and their exclusion negatively influenced the uptake and scaling of the efforts in these other regions because the managers felt that some of their crucial informational needs were being excluded.

The presence of certain standards can also lead to the proliferation of other standards, and with it, impeding scaling efforts. For example, since the ICD-6 standard, because of it being outdated, did not support different interest groups (such as HIV/AIDS program managers), five additional disease lists needed to be added. Since a number of these efforts were developed and disseminated locally, without proper coordination and with a sense of urgency to respond to the limits of the ICD 6 list, it created challenges in scaling from one site to another. While standards developed in one site can support scaling processes, they also can mask some local particularities that in the longer run can inhibit the scaling efforts.

The scaling of standardizing processes was facilitated through the incorporation of additional users and their acceptance of the standards. However, along with this it was also important to constantly enhance the functionality of the software (functional scaling) to be able to incorporate new needs. For example, in Addis the MM data could only be incorporated by the development of a new module, which had to be integrated into the DHIS. With this module in place, it became easier to include other sites and regions to accept the software, as their comprehensive (MM) reporting needs were met with this module. Furthermore, enhancement in the number of users also contributed to creating a greater diversity of interests (e.g. the reporting needs of different health programs), which in turn slowed down the scaling process.

Having 'succeeded' in Addis, the national capital could be seen as providing the HISP initiative in Ethiopia with a 'political' advantage, which in turn could potentially support further scaling processes. However, political climate in developing countries often shifts rapidly (Silva, 2002), and the advantage gained at one point of time can be seen as a disadvantage in another time and place setting, and could instead undermine scaling efforts (Sahay & Walsham, 2006).

In summary, processes of scaling and standardizing are better understood if analyzed in conjunction with each other, rather than as independent processes. Through our case study and its analysis, we have identified situations

where in some cases standards supported scaling processes but in other cases they undermined it. The political-institutional-health context is seen to mediate this relationship. There may be aspects of standardizing that are described to have a negative influence on scaling in our case, and that could contribute to positive influences elsewhere. Braa & Hedberg (2002) emphasize how the success achieved in the Eastern Cape Province in South Africa, because of its political visibility, helped the scaling process to other provinces in the country. This example emphasizes that while we need to look at standards and scaling together, the institutional-political-health context will mediate the relationship differently in varying settings.

Conclusions

The institutional analysis of the interplay between the processes of standardizing and scaling makes some important theoretical and practical contributions to the domain of IS research.

Institutional theory for IS

Through this analysis, two important theoretical contributions are identified: extending the domain of the application of institutional theory to (H) IS-related issues, specifically concerning the processes of standardization and scaling. These are now discussed.

Expanding the application of institutional theory to IS studies

In the context of IS research, an increasing number of studies are adopting an institutional perspective to examine processes of IT development, implementation and use (Orlikowski & Barley, 2001). However, a majority of these studies are concerned with explaining persistence of organizational processes rather than change.

In contrast to these studies, this paper demonstrates how institutional theory can be drawn upon also to explain processes of change, through the concept of 'mediation.' North's work on institutions has been drawn upon, specifically relating to the interplay between the formal institutions and informal constraints, to explain change, and also the limits to change. Initial standardizing efforts carried out by the authors in this paper could facilitate change in the creation of standards as they consciously tried to maximize the overlap between the formal and informal domains, exemplified through the case of the creation of maximum rather than minimum data sets. However, limits to the change efforts came when their work was confronted with the standardizing efforts of a higher institution, the Federal Ministry of Health – understood through the institutional concept of an actor in the organization field. Given the nature of the health sector, where standards of the regional and federal levels are inextricably inter-connected, the regional efforts could not be scaled beyond a point.

An institutional analysis of processes of standardizing and scaling is thus a contribution from at least two points

of view. Firstly, in treating these processes as institutional products rather than merely technological matters (like protocols and platforms) helps to deepen our understanding of these processes (Sahay, 2003). Secondly, the theory has been applied to analyze the processes of change and its limits, as contrasted with the condition of persistence that has been the case in a majority of IS research applications of institutional theory.

Expanding on our understanding of the concepts of standardizing and scaling

Typically, in the IS literature, the notions of standardizing and scaling are treated independently, thus arguably missing out on important interaction effects between these two sets of processes. At the first level, we have expanded how we understand standardizing which is especially relevant in the context of health care systems in developing countries. Standards have been described not only as technological artifacts, but also conceptualized as constituted of data definitions, reporting formats and also the work practices surrounding the various information processing activities. Failure of any one of these components, as has been argued in the paper in relation to making uniform the work practices, limits the overall standardization efforts. While Sahay and Walsham (2006) have argued that scaling is not about numbers and geography, but about complexity, they do not provide clarity on how to conceptualize complexity. We argue that through conceptualizing scaling as the spread of standards (including the three identified components), we are able to better operationalize complexity inherent in scaling. For example, the spreading of work practices related to new standards and their interaction with existing practices is inherently complex and is always going to be a non-trivial challenge.

Through our empirical work, various challenges to standardizing and scaling have been identified, and conceptualized through the concept of institutional mediation. Both standardization and scaling have been conceptualized as processes rather than as one-shot events, which again helps to extend our attention beyond the technical considerations, such as in looking only at protocols and software. This necessarily draws attention of researchers to the socio-technical and the heterogeneous nature of these processes. While it may be easier to implement technical standards such as of software, changing work practices are complex as these are historically and socially embedded. Health reforms even if formally mandated as institutions from the national level necessarily need to confront the local reality of informal constraints, and the larger the gap between the two, the more difficult it will be to get the change introduced. In a context like Ethiopia, where practices are deeply entrenched and there are serious resource constraints, the potential of this lack of overlap is magnified. For example, firstly resource constraints impede large-scale production of new paper formats containing the new standards. Secondly, the large

geographical distances make it difficult to speedily have these new formats distributed to all the health facilities.

How to improve HIS implementation with standardizing and scaling

Developing and implementing standards is a crucial aspect of health reform efforts ongoing in many developing countries. As has been pointed out by Braa & Hedberg (2002), implementing such standards in public health care setting is a non-trivial challenge. In these settings, standards are qualitatively different than as typically understood, such as TCP/IP used in the internet. The typical logic of 'network externalities,' which governs the spread of such standards, implying that users will adopt standards when they see others using it, does not play out with the same trajectory in public health.

In public health settings, standards need not be related to technical standards but can involve paper-based formats, associated with data and indicator definitions, reporting formats and surrounding work practices such as the periodicity of reporting. These standards are thus not 'hard' as technical standards, leaving more room for inter-subjective variations. The implementers of standards thus need to take extra care in understanding the different subjective worlds of the users and the need to shape the implementation of standards in a context-specific manner. The typical model of implementation using a diffusion logic in which standards defined from the top are spread and scaled to different user groups drawing on a logic of replication is unlikely to bear effective results. Instead, the need is to 'translate' the standards into the world of the users in a context-specific manner, for example by using extensive processes of capacity building. This implication, for example, should be taken up by the Federal Ministry of Health in Ethiopia in planning the implementation of the new standards in various regions and districts. Given the wide variations in context, in terms of infrastructure, user capacities and training resources, it is unlikely that a uniform logic of diffusion will work similarly in different contexts.

From the discussions above, the following practical implications can be drawn. Scaling and standardizing need to be treated as interdependent and not isolated processes. The scaling of standards need to be taken up in a manner which is context sensitive, and accompanied with extensive processes of user capacity development. This approach reflects logic of translation rather than diffusion.

While the theoretical and practical contributions developed in this paper are based upon empirical analysis carried out in Ethiopia, we believe that the study has broader implications for other regions in Ethiopia and also for other developed and developing countries. Developing and implementing standards is a broader IS endeavor and is not just restricted to health care sector in Ethiopia or other developing countries. The general

implication from our study is to examine scaling and standardizing as interconnected aspects situated within particular institutional and political settings. While the nature of the interaction effects might be different in varying contexts, the analytical focus on the interaction is useful to study the challenges of implementing HIS and IS more broadly, in both developing and developed country settings.

About the authors

Selamawit Molla Mekonnen is currently a Ph.D. student at the Informatics Department, University of Oslo. Since 2003, she has been involved in Health Information System (HIS) development and implementation in many developing countries. Her research interest revolves around the issue of HIS integration in developing countries; specifically, concerning exploring the link between organization culture and HIS integration.

While our empirical focus has been on one region, examining similar processes in other regions and also countries would help us to identify other mechanisms of standardizing, scaling and their interaction efforts. Scaling mechanisms to certain kinds of regions and countries will vary from others, and identifying and grouping different kinds of mechanisms that work in particular settings, we feel would be a useful future research effort.

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Paper II

Research Article

Interplay of Institutional Logics and Implications for Deinstitutionalization: Case Study of HMIS Implementation in Tajikistan

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Abstract

This article describes the efforts to reform the Health Management Information System (HMIS) of Tajikistan. The authors were involved in proposing and piloting a computerized HMIS based on a complete overhaul of the current data collection tools, as well as in planning for the scaling up of the system. One of the recommendations was to support local decision-making through a flexible, decentralized system to collect, process, and analyze essential primary healthcare data. The institutional logics underlying the current HMIS in Tajikistan were heavily influenced by the tenets of central planning from a deeply embedded Soviet system that was alien to the ideas proposed. This article explores the different institutional logics arising from what already existed and from our proposals, as well as the interplay among them over the course of the project. Clearly, a complete deinstitutionalization—amounting to a paradigm shift—is necessary to overcome the differences in institutional logics. However, this is a remarkable challenge, given a centralized control context. This study makes interesting contributions to the domain of IS/HMIS research in two ways: (a) by reporting from a country that until now has been almost invisible to the IS community, and (b) by adding to the debate around IS and organizational change through the lens of institutional logics and deinstitutionalization.

1. Introduction

Tajikistan is a Central Asian country about which little, if anything, has been published in the mainstream information systems (IS) and development communities. Gaining independence after the downfall of the Soviet Union in 1991, Tajikistan has experienced an extremely rocky period, with a prolonged civil war and the loss of the supporting Soviet financial and social infrastructure. The country faces further challenges that include an extreme climate, a long and porous border with war-ravaged Afghanistan, a recent food and energy crisis of gargantuan proportion (Antelava, 2008), and the exodus of many trained people due to weak employment and decreasing social opportunities at home.

As do other Central Asian countries, Tajikistan confronts urgent public health problems. The demise of the Soviet economic base, followed by civil war, has led to a surge in various communicable diseases in the last two decades. According to the World Health Organization, life expectancy

has decreased through poor nutrition, polluted water, and increased incidence of diseases (WHO, 2008).

Acknowledging the key role that ICTs can play in development and public health management, the Asian Development Bank (ADB) established the Health Sector Reform Project (HSRP) in 2005, with the aim of creating various reform initiatives, including those relating to Health Management Information Systems (HMIS). One of the four authors of this article was invited by the ADB to participate in the HMIS-related reform efforts. He enrolled the three other authors to create a joint team responsible for the design, development, and pilot implementation of the national HMIS. However, carrying out these tasks was fraught with immense challenges, most of which were related to countering the policies of the existing institutions left behind by the Soviet legacy, which favored a large manual system based on a centralized planning model. The research team's key efforts revolved around understanding and addressing these historical conditions and trying to create new institutions that were based on a computer-based HMIS and favored local analysis and use of information. These efforts resulted in two key research questions:

- What are the key institutions that challenge the introduction of ICT-based HMIS reforms in the context of a post-Soviet economy?
- What theoretical concepts inspired by institutional theory could help us to understand deeply the nature of these challenges, and how may these be addressed?

The remainder of the article is organized as follows: In section 2, we propose key theoretical concepts from institutional theory that help to develop our analysis; section 3 provides a brief summary of the research methods used; section 4 discusses the details of the case study; and section 5 presents the case analysis, based on institutional theory. That is followed by a concluding section on discussions and contributions.

2. Theoretical Perspective: Institutional Logics and Deinstitutionalization

The theoretical aim of the article is to develop concepts that can identify existing institutions that

shape the deployment of computer-based HMIS and their associated processes. The concepts of institutional logics and deinstitutionalization provide a framework for this by helping us to categorize actions and artifacts as belonging to underlying themes that represent the various forces in play, as well as to analyze the interplay among them. First, though, we present an overview of institutions and institutional theory, as applied to the information systems field.

The basic building block of institutional theory is the concept of *institutions*, which has been diversely defined within the domains of economics, political science, and sociology. For example, economic historian Douglas North defines institutions as human-devised rules in a society that shape human interactions, or the "rules of the game" (1990, p. 3). While formal rules include political rules, economic rules, and contracts, informal rules include taboos, customs, and traditions (Jepperson, 1991). Both formal and informal institutions help to give pattern to human or organizational behavior by enabling and constraining their activities.

In the context of sociology of organizational studies, the definition of institution has been expanded by DiMaggio and Powell to include the unintentional activities of human beings, an aspect not covered in the definition of North. "While institutions are certainly the result of human activity, they are not necessarily the products of conscious design" (1991, p. 8). From a sociological perspective, Jepperson elaborates on institutions as follows:

[I]nstitution represents a social order or pattern that has attained a certain state or property; institutionalization denotes the process of such attainment. . . . [O]rder or pattern . . . is conventional to standardized interaction sequences. . . . [W]hen departures from the pattern are counteracted in a regulated fashion, we refer to a pattern as institutionalized. (1991, p. 145)

In trying to reconcile the multiplicity of definitions given by various researchers, Scott defines institutions "as multifaceted, durable social structures, made up of symbolic elements, social activities, and material resources" (2001, p. 49). In a subsequent publication, Scott elaborates on the distinctive properties of institutions, as they are resistant to change and tend to be transmitted across generations through different mechanisms, by argu-

ing that “institutions are comprised of regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life” (2008, p. 48). This article draws from Scott’s definition, further articulating how conflicting institutional logics erode what are seemingly stable institutions and contribute to the creation of new ones.

Institutional Theory in IS

In IS research, an increasing number of studies have adopted an institutional perspective to examine processes of IT development, implementation, and use, with a focus on institutional influences on technological changes (Orlikowski & Barley, 2001). For example, an early study by Kling and Iacono (1989) shows how a computer-based IS with stable structures was difficult to change. However, Fountain (2001) criticizes IS studies for ignoring the role of IT in shaping existing institutions, and for not acknowledging the reciprocal effects between institutions and technology. In a similar vein, Avgerou (2002) argues that IT, on its own, can be considered as an institution that can be seen to account adequately for the processes of transformation of organized activities in a society. From the perspective of HMIS, Noir and Walsham (2007), drawing on empirical material from the Indian healthcare sector, describe the ceremonial roles that “ICT for development” plays in legitimizing development initiatives. Similarly, based on their work in Ethiopia, Mekonnen and Sahay (2009) discuss how the institutional context mediates the processes of standardizing and of scaling of health information systems. Though most IS studies have adopted the theory to understand stability of institutions and resistance to change, they have given limited attention to how institutions change or erode away—in short, to how processes of deinstitutionalization take place (Oliver, 1992). Our study contributes to this debate through the analysis of contradictory institutional logics that lead to the process of deinstitutionalization.

Institutional Logics

The concept of institutional logics was initially introduced by Alford and Friedland (1985) to describe contradictory social practices, though it was subsequently expanded by others (e.g., Thornton & Ocasio, 1999, 2008; Scott, Ruef, Mendel, & Caronna, 2000). For example, Thornton and Ocasio define institutional logic as “the socially constructed,

historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality” (1999, p. 804). These logics inscribe the “organizing principles” that supply practice guidelines to field participants, guiding both the means and ends of individual behavior (Friedland & Alford, 1991). Institutional actors, then, can be viewed as agents and carriers for producing and reproducing the logic within a specific institutional environment (Scott et al., 2000).

Institutional logics work at different levels, both within institutions, such as health services, and between institutions, such as the various professions engaged within health services. In addition, actors are part of other institutions that are apart from, though not independent of the institution in question. For example, religion, marriage, cultural, and ethnic boundaries carry their own logics to govern behavior (North, 1990; Ingram & Klay, 2000), and people engaged in the health sector also operate within the boundaries of these institutions. Decisions are thus not only based on individual agency, but are greatly formed by the institutions in which actors operate, and from which they draw legitimacy and identification (Jackall, 1988; Friedland & Alford, 1991).

Institutional logics are never homogeneous; within an organization, multiple logics may be simultaneously in play, contributing to institutional contradictions (Friedland and Alford 1991). For example, in the context of Geographical Information Systems (GIS) use in the forestry sector in India, Sahay and Walsham (1999) elaborate on two logics in play. The first concerns how foresters make decisions on forest management based largely on political and social considerations, such as the Minister of Environment and Forests wanting to implement water conservation activities in his political constituency. The second concerns the contradictory logic inscribed in the GIS, which is itself based on making such decisions (of locating forestry interventions) via scientific modeling enabled through the GIS. The interplay of these two logics, Sahay and Walsham point out, contributes to the less-than-effective uptake of the GIS in the forest department.

Such contradictory logics can also provide the potential for eventual change. Thornton and Ocasio (2008) discuss four mechanisms of change: (a) insti-

tutional entrepreneurs, who are agents of change and play a critical role, taking advantage of the position they assume in social locations; (b) structural overlap, which occurs when previously distinct organizational structures are forced into association; (c) event sequencing, or the temporal and sequential unfolding of events that dislocate and transform interpretation and meaning of cultural symbols; and (d) competing institutional logics that may facilitate resistance to change and can be pre-existent or a consequence of change. For example, Currie and Guah (2007) illustrate how competing institutional logics (the change initiator vs. healthcare practitioners) influenced an IT-enabled change in six UK National Health Services. It is also worth noting that institutional change brought on by a change in the institutional logics does not necessarily happen from the periphery. The exposure to different institutional logics may increase the awareness of shortcomings of the dominant logics and enable central actors to become institutional entrepreneurs (Greenwood & Suddaby, 2006; Thornton & Ocasio, 2008).

Deinstitutionalization

Negotiating and reconciling conflicting institutional logics may contribute to the deinstitutionalization of the existing logic and re-institutionalization of the new (Jepperson, 1991). Deinstitutionalization is “a process by which institutions weaken and disappear” (Scott, 2001, p. 182), and it “takes place when established meanings and action in an organization are discredited, either as a result of competing meanings and actions or because they are seen as failing to contribute to the institutional *raison d’être*” (Avgerou, 2002). Further, Oliver describes deinstitutionalization as

the process by which the legitimacy of an established or institutionalized organizational practice erodes or discontinues. Specifically, deinstitutionalization refers to the delegitimation of an established organizational practice or procedure as a result of organizational challenges to or the failure of organizations to reproduce previously legitimated or taken-for-granted organizational actions. (Oliver, 1992, p. 564)

Oliver points out three key factors that contribute to deinstitutionalization: political, functional, and social. Political pressures may evolve under threat of erosion or displacement, as new and emerging practices may challenge the utility and legitimacy of

existing ones. Functional pressures relate to technical or functional considerations that may compromise or raise doubts about the instrumental value of an institutionalized practice. Social pressures include increasing normative fragmentation within an organization as a by-product of other changes, such as increasing workforce diversity or addressing the problem of high turnover. There can be disruptions to an organization’s historical continuity, such as mergers, or changes in state laws that can prohibit or discourage the perpetuation of an institutional practice and its associated deinstitutionalization. For example, Nicholson and Sahay (2009) observed the role of dissensus and consensus—around both political and cultural factors—in the software exports policy-making process in Costa Rica, with the former leading to erosion of institutions, and the latter reinforcing existing institutions. Apart from intentional change processes (for example, purposely dissenting), there can be unanticipated or unintentional consequences of purposive activities leading to new institutions (Hwang & Powell, 2005). Moreover, Currie (2009) illustrates how functional pressures were confronted by normative pressures in deinstitutionalizing the existing professionally dominated UK healthcare sector to a new institution based on market mechanisms.

In summary, the focus of our theoretical analysis is to first identify the existing and proposed institutional logics surrounding the introduction of computer-based health management information systems in Tajikistan. The concept of deinstitutionalization further helps us to theoretically understand the interplay between different logics, why certain logics stay, why others erode away, and what social, political, and functional pressures contribute to this.

3. Research Methods

Research Approach

A useful method to develop and implement an HMIS in developing countries, suggested by Braa, Monteiro, and Sahay (2004), is that of action research, based on the principles of “networks of action” (p. 339). They build this argument within the context of a global interaction identified as the Health Information System Programme (HISP), which involves, among other things, the design, development, and implementation of a free and open-

source software called the District Health Information Software (DHIS). Taking their point of departure of trying to address the commonly perceived problems of lack of sustainability and scalability of HMIS in developing countries, the three authors draw on Elden and Chisholm (1993) to argue for the need to carry out action research in networks, rather than in singular units. Such an approach, they argue, provides the potential for multiple sites to learn with each other, share experiences and knowledge, and plan and implement action in a context-specific manner.

With this in mind, we applied an action research approach and addressed the question of network-building at both a global and local level:

1. Global level: Examine how the global HISP network could be leveraged to support the process of adaptation to the local context of Tajikistan, and mutually, how the global network could learn from the Tajikistan experience.
2. Local level: Within Tajikistan, understand what kind of sociopolitical, technical, and health-related networks could be mobilized to support overall project aims of HIS-related reforms.

The specific interventions that we carried out with respect to building these networks of action at the two identified levels are summarized in Table 1.

Data Collection Methods

Data were collected through various means. The following two tables summarize the data collection methods applied. While Table 2 provides detail about the type of methods we used and when they were conducted, Table 3 sums up the respondents by institution, issues raised, and length of the interview.

Data Analysis

At the end of the intervention in Tajikistan, while organizing our material, it became clear that most of the challenges encountered could be ascribed to different mindsets. This led to a categorization of events into these conflicting mindsets. The interview transcriptions and meetings notes were increasingly seen in this light, and we distilled the underlying

assumptions that led to the different views. This, in essence, led to the institutional logics discussed in this article, while the literature review was not initially focused in this direction. It increasingly became clear, however, that theories of institutional logics provided us with the language to analyze and communicate these findings.

4. Case Study

The project started when a University of Oslo professor was invited by the ADB (Asian Development Bank) to work with HSRP on the design, development, and implementation of a computer-based HMIS in Tajikistan. The project was carried out over an intensive period of about three months from November 2007 to early February 2008. Broadly, the project components involved an initial situation analysis and identification of local technical partners, followed by a month of systems development and the pilot testing of the first prototype, and then by two weeks of initiating pilot testing in one district (Kulyab). The case narrative is structured in two sections: (a) the existing situation that highlights institutional logics already at play; and (b) the HMIS intervention, which summarizes proposed institutional logics. In both these sections, the focus is on artifacts and processes, which are the manifested expressions of the institutional logics we studied. At the end of each section, we have distilled out the institutional logics they represent.

Existing Situation: Institutional Logics at Play

Central control of the HMIS was under the Medical Statistics division (MedStat), which, true to its name, treated the HMIS as an annual statistics-generating tool. The MedStat division used out-of-date software (also called MedStat) built on a FoxPro platform that basically was capable of entering data on the existing 37 reporting forms by the facilities and generating the aggregated reports by rayons, oblasts,¹ and nationally. From the reporting forms, two were reported monthly, and the rest were done annually. MedStat was not capable of generating any indicators (such as percentages or rates per thousand that required calculation with a numerator and denominator). For this purpose, the required

1. Rayon and oblast are the Tajikistani equivalents of district (typically 50,000 to 100,000 inhabitants) and province (10 to 15 districts), respectively.

INTERPLAY OF INSTITUTIONAL LOGICS AND IMPLICATIONS FOR DEINSTITUTIONALIZATION

Table 1. Interventions and Their Relation to "Networks of Action."

Action interventions carried out in Tajikistan	Global network building and leveraging	Local network building
Situation analysis: Document study, interviews, presentations, discussions	<ul style="list-style-type: none"> • Adopt best practices from global experience to the specific needs of Tajikistan • Gain experience from Central Asian primary health care practices 	<ul style="list-style-type: none"> • Enroll participation in HMIS reform process • Establish local network covering the fields of health and IT • Build awareness of HMIS challenges and ways to address them
Software development: Expand functionality, database design, application translation, report generation, creating validation rules	<ul style="list-style-type: none"> • Adapt Global DHIS to the Tajikistan context • Advance DHIS with new functionalities developed in response to Tajikistan requirements • Enroll Tajik competence in global DHIS development • Establish a software development node in Tajikistan that could potentially serve as a future hub for Central Asia 	<ul style="list-style-type: none"> • Develop a local team committed to free and open-source software development • Develop feedback mechanisms between users of DHIS in the district and the developers • Build capacity of local team to support HSRP and build the community of users
Capacity building: Training sessions and follow-up activities at district and national levels	<ul style="list-style-type: none"> • Adapt training material and practices from other settings to Tajikistan • Contribute to global repository of training material and examples from Tajikistan • Create training material in Russian that could be made available to other Russian-speaking nations 	<ul style="list-style-type: none"> • Formalize training procedures and content for health information officers • Develop training capacity at national and district level • Conduct orientation training to help create greater buy-in and support

data were fed in separately to a WHO-created program called Data Presentation System (DPS), and the generated indicators were uploaded into a national Web site. Another program, Factor, obtained data from the oblasts on five variables related to maternal health. Electronically, the three programs did not "speak to each other," despite all being under the control of the MedStat division; the IT specialist said there were no plans to further upgrade the MedStat software.

Below the level of the 37 forms that corresponded to different health programs (with a great deal of overlap and redundancies) were another 367 recording forms used at the primary health facilities to record the provision of basic services. At the rayon level, the different health programs put their respective data on MedStat forms, which were then sent to the corresponding oblast health program, as well as to the Statistical Department at the Central Rayon Hospital. Further, there were parallel report-

ing systems in place, with both the health programs and the MedStat department sending the same information to their corresponding superior level. However, since the MedStat software was not compatible with other software, computer use was limited. A tuberculosis (TB) program manager described this:

Also, we have 16 computer specialists, but only in Kulyab and Dushanbe. But the problem is we cannot use the data from Kulyab and Dushanbe which is entered in Epi Info, because we have to adapt the data to be entered in MOH formats. So, to MedStat, we only send data on written form . . . this is a structure which is more than 75 years old. (TB program manager, Dushanbe, November 2007)

Further, poor IT resources in particular health divisions further impeded the use of computerized data, as related by a deputy director of the national TB program:

Table 2. Overview of Data Collection Methods.

Type	Nature and volume	When
Interviews	10 at national 6 at district	Situation analysis Pilot implementation
Presentations	4 for Asian Development Bank (ADB), Ministry of Health (MOH), donor partners, and closing presentation for HSRP, MedStat, and MOH	Situation analysis and at end of project
Workshops	Training and discussions: one for national level participants, one for province and district level, and one in pilot district for district health programs	Launch of Version 1: Tajikistan HMIS and pilot project
Document study	Previous projects reports, current reporting forms	Situation analysis
Informal discussions	Numerous with HMIS consultant, HSRP staff, local software developers	Daily
Participant observations	Use of MedStat software at national and district level. Study of information flows and practices around recording of data, use of registers, and so forth	Regularly
Data collection through e-mails	E-mails with HMIS consultant, software team, and among ourselves	Continuous and ongoing
Software prototyping	During definition of datasets, creation of reports, identification of controls	Continuous and ongoing

Table 3. Interviews Conducted.

Institution	Respondents	Types of issues raised	Time
Different national health programs	Deputy director or director level	Current system and its challenges, data quality, information needs, information gaps	1.5 hours
Different district health programs	District or central district hospital program directors	Information flow, use of information, reporting routines	30–45 minutes
International NGO	Country representative and HMIS representative	Past experiences of HMIS implementation in which they were involved	1.5 hours
Local software entity	Director and staff	Technical and infrastructural challenges related to software implementation	1.5 hours

We want to include all data in Tajikistan, but some is always missed. Now we need one IT specialist and train him full time to work on Epi Info. How we reach the 66 centres, when we have no budget, no travel money, no nothing? (Deputy director of the national TB program, Dushanbe, November 2007)

Further impediments to the use of computers were the availability of and permission to use paper. We were told that paper was not regularly provided, and that the limited budgets did not allow for its local purchase. For instance, in the Kulyab district, the yearly budget for gasoline would be spent in

just a couple of weeks of normal activity, so the purchase of paper was not a high priority. A donor agency senior official narrated how inventive methods were applied to produce reports at the local level:

When asked how the reports were prepared, he (a doctor at the rayon level) said he will tell (about how reports were prepared) if his name is not quoted. He said he bought one chocolate to the room of the specialist responsible for the data. The specialist generated the report for the whole district. We (the aid agency official) told [the director of MedStat] that this is the cost of

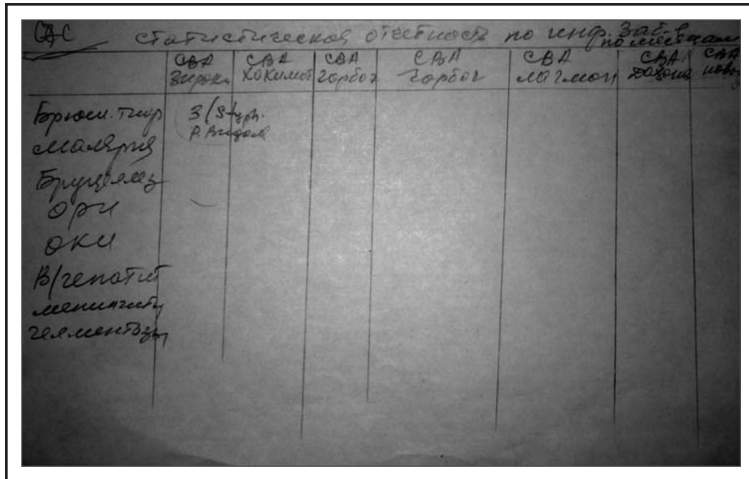


Figure 1. Emergency Form on Infectious Diseases with Key Diseases (listed in rows) and Rural Health Centers (listed in columns).

institutional logics at play. They were not the only institutional logics identified, but they were dominant and stood out because they so clearly contradicted what we tried to introduce (see next section for explanation). The first was a central planning logic—perhaps a set of logics—where a curative, rather than preventive, approach was taken. This was evident by how the data were collected for top-level use only, with the focus being on collecting raw data, rather than on calculated indicators, on an annual basis. Supporting this was the HMIS-inscribed logic, where we found the system to be built for one purpose only: the provision

of statistics for central planning. It was not designed to support local use, as evidenced by the extra emergency form that the Kulyab district office had developed for this purpose. Related to this is the gigantomania we mentioned earlier of wanting to cover—to the smallest detail and on a routine basis—all data that could be related to health. For much of the data, it makes more sense to do periodic surveys, rather than to aim for complete national coverage of data collection every year. The other key logic was one that linked to paper technology, in that once the forms had been agreed upon, they could not be revised before the end of the five-year planning period. Even when showing how improvements could be made to the forms, the perceived costs of such action were based on a completely paper-based system. In a computerized environment, this rigidity becomes meaningless.

your reporting system—one bar of chocolate. (Donor agency official, Dushanbe, November 2007)

Given the huge amount of the data to be reported (about 30,000 data elements) on a routine basis, the extremely poor HMIS-related resources, and the view that reporting was an irrelevant exercise, data quality obviously suffered. The head of the HMIS task force at the MOH admitted that the use of the ICD 10 codes for classification was fraught with errors, and he estimated that 35% of the data in this system would be incorrect from classification errors itself.

The reporting forms were poorly designed and comprised multiple subforms. For example, we found a form titled “Treatment Prophylactic Activity of Facility” that contained about 50 subforms, covering 1,836 data elements and spanning about 75 pages. This “gigantomania” fostered intermediate forms that were designed locally for local use. For example, the Infectious Diseases Department at the central district office provided what they called an “emergency form” that listed eight essential diseases (with space left for others) reported by the different rural health centers (shown as columns). This form (Figure 1) was used for local purposes in addition to the standardized recording and reporting forms that were prepared for national reporting.

Based on these findings, we identified two key

existing institutional logics we identified are summarized below:

- Central planning for statistics management (supporting curative rather than preventive health), based on:
 - Centralized structure rather than decentralized.
 - HMIS as annual statistics-generating tool.
 - Gigantomania collection of extensive data signals, seriousness, and scientific vigor.

- Rigidity of paper means that decisions are final and static for the duration of planning cycles. Computers can be employed to automate paper-based systems.

HMIS Intervention: Proposed Institutional Logics

The proposed HMIS was a system based on a free and open-source HMIS application designed and developed under the HISP network (Braa & Hedberg, 2002). The institutional logics behind our suggestions were based on: (a) a belief that local decision-making produces the quickest and most appropriate response to emerging health issues, based on routinely collected essential data; (b) the HMIS thusly being indicator-driven, so as to be able to compare across time and space, as well as to collect data that is necessary for taking local action, which we strongly believe is the result of; (c) a much smaller data set to reduce the burden of collection, improve quality, and enable decision makers to process it adequately; and (d) technology's role being to internalize routine aggregation, increase flexibility, and decrease response time, rather than to increase the capacity and speed of a system that adhered to a paper-based design logic and five-year planning cycles.

A first step in the design process was the reorganization of the existing data forms. We proposed to organize health data in relevant health categories rather than on forms. Further, we suggested that data be organized into two broad categories: routine data (reported monthly) and semi-permanent data (reported annually).

In addition, we suggested a radical reduction of data to be collected and a shift to indicators (rates and ratios), rather than just data elements (counts). A smaller system would have a positive impact on both time consumption for data entering and ambiguities related to correct use. Hopefully, it would also help to improve the level of data quality. Through shifting the focus from counts to indicators, the data would assume relevance for decision-making across time and space.

However, our proposal for redesign based on data sets (and not forms) was rejected. We were told that the Central Statistics Authority had approved the existing 37 reporting formats, and that we were not even allowed to change or add a logo to the form. We were not even allowed to change

the location of a single piece of data in the existing formats. So, we then made a design decision that each of these reporting formats would represent a data set, with groups defined in each of them, and with each corresponding to a subform. Our design approach, then, resulted in the development of a maximum data set, rather than a minimum data set. We rationalized this rather unpleasant decision to automate existing inefficiencies by telling ourselves that this one-to-one approach would allow us to input the existing data into the computer. This step could then be followed with analysis of existing data, which would make the poor data quality visible to the planners, and thus allow us to make a stronger argument for applying a minimum data set approach in the next iteration. But, as the World Bank representative noted, a smaller system was not seen as compatible with central planning, and he was skeptical about our chances of success:

We wanted to simplify the system. When the consultant showed the MOH a system with 15 indicators, they laughed, how can it meet the needs of the health system? They laughed and did not accept it. This is the paradox—we want a huge system, but don't have the money. They are suspicious of small systems. (World Bank representative, Dushanbe, November 2007)

The issue of control rules is worth mentioning. The tabular forms in MedStat required many data items to be recorded twice. For each row item, such as Malaria, there would be columns both for age groups and gender, as well as a column for the total. Data would then appear twice, both in a specific age group and in the total. In the software application (DHIS) introduced, data items could be calculated automatically by aggregating other items; totals, then, can be produced on demand and not have to be entered at all. This could reduce the amount of data items by around 3,000. However, this automatic aggregation of totals was not to be implemented, as it was still the MedStat administration's intent to manually enter totals and then run checks on them against their various components. This function had been included in MedStat software with a set of so-called "controls." These controls made sense in a paper system, where manual aggregation into totals could produce errors. This "paper verification logic" was applied to a computer system where the possibility of manual aggregation

error could be eliminated altogether. The MedStat team insisted that development of the same set of controls in DHIS as in MedStat be a compulsory requirement. These examples of often-contradictory assumptions and directions point to the different underlying institutional logics in play; they also helped us to identify our beliefs and assumptions as also being rooted in certain logics.

The HMIS intervention-related institutional logics we identified are summarized below:

- Decentralized decision-making, based on routine data, specifically:
 - HMIS is indicator- and action-led.
 - Small, essential data sets best support action and improve data quality.
- Computer systems should be employed to internalize routine aggregation, increase flexibility, and decrease response time to changes in epidemiological information needs.

5. Analysis: Interplay of Logics and Implication on Deinstitutionalization

In the case study, we elaborate on the institutional logics found to be in play when conducting the situation analysis of the HMIS in Tajikistan, as well as the logics that we believed were inscribed in the HMIS-related intervention that we were seeking to introduce. In this analysis section, we will describe the interplay of these two sets of logics and how this shaped the deinstitutionalization process we wanted to bring about in the existing HMIS. Specifically, we discuss two sets of interplays:

1. Statistics for central planning and control versus using information for decentralized action
2. Rigidity of paper-based reporting formats versus the flexibility of customizable electronic forms

Statistics for Central Planning and Control Versus Using Information for Decentralized Action

The Tajik system is a historical product of a Soviet system of governance, and nearly two decades after the collapse of the USSR, the deep-rooted Soviet institutions can still be seen in play. In another context of collectivization (before WWII), this has been

described by Scott (1999) as “gigantomania,” referring to the focus on trying to collect huge amounts of data as a form of centralized planning and control. In the post-Soviet system in contemporary Tajikistan, the routine health system seeks to collect data on more than 30,000 data items relating to all kinds of diverse items, such as soil samples, airplane vibrations, and cigarette smoking, as well as health programs.

Further, the Soviet system prides itself on being based on a strong scientific foundation. This historical tendency is reflected in the Tajikistan’s MOH decision to use the full version of the ICD10 system. The implication of this was that each disease was classified by various codes, and that each code had various subcodes and sub-subcodes. In the Soviet era, when there was a high level of scientific and technical experts, the data collected from the peripheral levels was subjected to a serious scientific scrutiny at the central level. Now, however, the number of such experts has been dramatically reduced. While similar levels of detailed data are expected to be collected, there has also been a simultaneous decrease in both the capacity to collect good quality data and in the skills to analyze and use the data.

In contrast to this existing system, the HISP philosophy—under which all authors have been working for years in other countries—toward HMIS development can be seen to be a historical product of postapartheid 1994 South Africa, a period of ANC-driven reform that was based on an agenda emphasizing decentralization and integration (Braa & Hedberg, 2002). Within this context, the HISP project sought to develop free and open-source software that could be installed at the local levels. Large-scale capacity-building programs would be carried out to empower health workers and compel them to use information for local action. These principles and practices of the HISP initiative were inscribed into the design of the DHIS software, which emphasized local flexibility and user control, and became part of the training material used for processes of capacity-building for the health staff.

However, adapting these principles of use of information for local action in Tajikistan would involve incorporating a whole range of HISP principles, including the creation of a minimum data set, the linking of data being collected with indicators, and the implementation of large-scale capacity

building programs of the health staff, with a focus on the use of information at the local level. However, we soon realized that these aims were unattainable in the present scenario. First, no permission could be obtained to make any changes—even the removal of duplicate data elements included in the same form. Further, the system we found was not mature enough to absorb the shock of these large-scale and radical changes. Since even the basic information processing systems were not in place, such as those for collecting quality data, it was too ambitious on our part to expect local staff to start on the analysis of data. Further constraints included the poor capacity of the health staff, very weak infrastructure, and the extreme climatic conditions that made it difficult to travel to the districts to carry out the training programs.

The interplay of the two sets of logics thus resulted in our adapting a strategy of maintaining the status quo in terms of the reporting forms, their numbers, and their design, but by translating this status quo into an automated form. We reasoned that the information inscribed in this status quo system would spotlight the poor quality and the absurdity of the current design. We believed this could help us make a stronger case for change in the future, and when changes were approved, we would be able to easily adapt the system to the flexible DHIS-based HMIS application.

Rigidity of Paper-based Reporting Formats Versus the Flexibility of Electronic Customizable Forms

For both institutional and technical reasons, the paper formats in use were inscribed with a deep sense of rigidity. Institutional reasons for this included the costs associated with the production of new formats, the logistical problems of reproduction, and the difficulty of distributing them to hundreds of facilities, some of which were located in geographically inaccessible regions. The size of the individual forms made the task of changing a paper-based form daunting. Furthermore, the existing forms had only recently been approved by the Central Statistical Authority, so no further revisions could be made for at least five years, which corresponded to the national planning cycle. The technical reason contributing to the rigidity of the form was their much-cluttered design, full of multiple rows and columns. Some of the forms had approximately 250

rows and 12 columns, making them very difficult to modify in technical terms.

Bathed in the philosophy of flexible systems and local action, HISP saw forms as something very flexible that could be modified at will, based on user needs. The entire software had been built on a modular structure, and changes could easily be made at the data entry level without affecting other parts of the system. Furthermore, some technical innovations were created by the software development team, particularly the “multi-dimensional” data element that was developed to replace the existing uni-dimensional data element. Through this innovation, previous multiple uni-dimensional data elements (for example, children in different age categories were treated as different elements) could now be treated as a single data element (children) having multiple categories (representing age groups). This innovation was combined with the development of a customized data entry screen that replicated the paper form versus having to enter data through a list of data elements organized vertically. The following screen shots (Figures 2 and 3) illustrate the two systems of data entry. The combination of these two technical innovations provided our team with a great deal of flexibility in the design of the forms.

The interplay of these two logics occurred when we started to make suggestions in the design of the screens, showing how space could be used better, or by making aesthetic-based improvements. However, we still did not get permission to make changes. When we suggested trying out some new designs on an experimental basis—we could revert back to the original design if they did not work—we were again denied permission to make these kinds of revisions.

Interplay of Logics and Implications for Deinstitutionalization

As Oliver (1992) has pointed out, deinstitutionalization arises from social, political, and functional pressures. If these pressures gain enough momentum, they can create a sense of dissensus in the existing institutions and provide the impetus for their dissipation or erosion. In the case we described earlier, the interplay of the institutional logics could show a great deal of functional dissensus and demonstrate how the existing system was operationally inefficient, based on receiving poor quality data and

1. INFECTIOUS DISEASES																	
Name of disease	№ row	Code ICD-10	Registered diseases									From paragraphs 3, 4, 5, 6 organized		Rural inhabitants		Registered death cases	
			Total	From them								Nursery visits	Visits of kindergarten	Total	including 0-14 years	Total	including 0-14
				0-14 Years old	0-1 Years old	1-2 Years old	3-4 Years old	5-6 Years old	7-14 Years old	15-17 Years old	18-19 Years old						
A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Infectious diseases, total	1																
Cholera	2	A00															
Vibriocarrer of cholera	3	Z22.1															
Abdomnal typhoid	4	A01.0															
Paratyphoid A, B, C	5	A01.1,2,3,4															
Bactenocarrer of abdominal typhoid and paratyphoid	6	Z22.0,1															
Other salmonellosis infections	7	A02															

Figure 2. Form 1 Customized Data Entry Form (English version).

Nr	Data Element	Min	Entry	Max	Comment
1	cholera		<input type="text"/>		[No comment] <input type="button" value="v"/>
2	infectious disease total		<input type="text"/>		[No comment] <input type="button" value="v"/>
3	vibrocarrier of cholera		<input type="text"/>		[No comment] <input type="button" value="v"/>
4	abdominal typhoid		<input type="text"/>		[No comment] <input type="button" value="v"/>

Figure 3. Form 1 With Data Elements Listed Vertically in Standard Layout.

providing data that could not be used. We demonstrated this functional deficiency through our analysis; for example, we showed that nearly 90% of the data was being reported as zeros or blanks on some of the forms. We also argued that while a huge amount of data was being collected, no indicators were being used. The Ministry of Health, however, insisted that all data being collected were being used as indicators. When we showed examples to the contrary, they were simply dismissed as being exceptions.

A degree of social pressure had been placed on the MOH to reform their HMIS through efforts of the World Bank and the ADB that had created specific structures (for example, the HSRP office) for guiding reform efforts. However, as the HSRP was an independent structure and had a time-bound life of three years, its recommendations were non-binding for the MOH. On the political front, we failed to create adequate momentum and pressure to trigger change. The political decision-making center was at the MOH, an organization closely aligned with MedStat, so our influence there was minimal. Our alignment was with the ADB, primarily considered a donor (and that in the form of loans) and thus not sufficiently powerful to enforce change.

In summary, it could be seen that the interplay of logics primarily occurred on the functional domain. Confronted with a strong, historically embedded system, we could hardly make a dent on the political domain. However, where we did succeed was in creating some seeds of change, primarily by building a system with an inscribed flexible logic that could be modified into a more effective HMIS in the future (when political conditions might be more favorable). Also, through our various reports and presentations, we introduced new discourses into the HMIS reform efforts, such as those related to use of information, use of indicators, and data quality and validation. So, while some seeds for deinstitutionalization were planted, there was not adequate political pressure for deinstitutionalization to take place at the time. We should also note that institutional change processes can be painfully slow. Future efforts in this direction could focus on gathering a critical mass of supporters with enough power to influence these change processes. However, while arguing for even piecemeal change at the ministerial level, we found a reflection of our own ideas and philosophies in the pilot district of Kulyab. There, the so-called emergency form captured precisely the kind of logics with which we had become acquainted in

South Africa. The district needed a limited set of data on notifiable diseases to be able to manage and assist its rural health centers in case of an outbreak. This form was not part of the official HMIS, but the doctors and managers maintained this extra system, despite all the work they required to complete the official forms. From this, it is clear there were domestic seeds of conflicting logics, but the (weaker) district's strategy was to avoid conflict. The training in data analysis in Kulyab, using local data, was met with a degree of enthusiasm beyond what would be found at the national level. These local-central differences in logics guiding behavior were also found in a similar study in Cuba (Sæbø & Titlestad, 2004), a country sharing some political and economic history with Tajikistan.

7. Conclusions

The interplay of the two sets of logics basically involved two paradigms, which at one level were irreconcilable and could not coexist. However, we believe that in such a historically embedded system, a paradigm shift could only come about if mandated explicitly from the top political authority—the health minister. While local level incremental efforts may be useful to create some local expertise and knowledge, these lower levels have no authority or voice to influence change. The strategy of local empowerment, which had worked for the HISP project in South Africa, was a product of the historical moment that existed, one arising from the breakdown of the apartheid system and the political agenda that mandated decentralization and integration.

This study makes some interesting contributions to the IS field. First, it brings into focus a study from a country that, to date, has been nearly invisible to the IS community. Hence, the article expands the already existing knowledge about IT-enabled HMIS change process in developing countries. Second, it contributes to the debate about bottom-up and top-down implementation models by arguing that such decisions are products of historical circumstances, and that bottom-up, though ideologically appealing, may not be always most effective. Third, the conceptual framework of institutional logics, their interplay, and implications for deinstitutionalization provides an interesting approach to study implementation experiences more broadly, not just HMIS in a

post-Soviet republic. In other circumstances, there would be different forms of logics in play; studying them would provide rich insights into the implementation dynamics. ■

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Paper III

Understanding the Role of Social Capital in Integrating Health Information Systems

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Abstract.

This paper empirically explores the importance of social capital for the integration of Health Information Systems (HISs) by drawing a case study from Gujarat state of India HIS integration initiative. In light of the main tenets of social capital such as trust, social relation and networking, the paper gives a fresh perspective regarding how the existing fragmented and disparate instantiations of HIS could move towards a coherent whole. Detailing the socio-technical challenges faced during this initiative, we tried to show how the position, background and social status of the implementers contributed in creating trust and networking among the various stakeholders, which in turn led to integration of the HISs.

Keywords. Health information systems; integrations; social capital; trust; social networking.

1. Introduction

The Significance of integrating Health Information Systems (HIS) has been emphasized both in research and practice of health reforms (Chilundo and Aanestad 2005, Smith, Madon et al. 2007, WHO 2008, Sahay, Monteiro et al. 2009). However, the realization of fully standardised and integrated information systems has been fraught by various socio-technical challenges needing a socio-technical understanding to cope with them. In a socio-technical perspective integration of systems refer to the linking of various disparate systems and associated practices. The importance of such linkages is emphasized by the adverse effects of fragmented HIS with respect to data quality, utilization of resources, and the adoption of a coherent and comprehensive health systems approach to health reforms. However, integration may not always be the most efficient approach, as there may be particular problems such as the management of epidemics which may be more suited to a management approach around vertical programs rather than a district based geographical area focused approach as advocated by the primary health care model. This in turn raises questions such as what should be integrated, how and by whom. For example, drawing case material from the Nigerian Health Care Sector Oluwagbemi and Philip (2010) proposed integration of the multiple ISs following a multi-tier application in the health domain. While these issues are relevant, this research focuses on other; perhaps, less addressed nonetheless crucial aspects such as on how trust, social relation and networking framed under the notion of “Social capital” may contribute for integration

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efforts.

While, at present research and practice in HIS can be argued to have a fair focus on both the social and technical aspects of integration efforts, the notion of social capital has not yet received the required empirical investigation in IS studies. The technological perspective of integration focuses mainly on how newer and more modern technologies can be applied to address hitherto unaddressed fragmentation challenges. For instance, Enterprise Resource Planning systems, Service Oriented Architectures, Web-based systems, are being tried out as tools for spearheading integration initiatives. On the other hand, researchers who studied the social aspect of integration emphasised the social and political determinants of integration suggesting the need for enrolling and aligning the interests of the various stakeholders. As a result, it is increasingly being recognized that integration of information systems in general and HIS in particular, is as much a technical exercise as it is about addressing the institutional, social and political conditions. In continuing with this line of research, this paper analyses the role of social capital in the integration of HIS in the context of developing countries.

The notion of social capital has its roots in social sciences, and commonly refers to the investments made to build cooperative activities in organizations that have a potential rate of return (Cohen and Prusak 2001). When we invest in infrastructure, we get infrastructure in return, and in the same vein, when we invest on building social networking, we get more of what makes the infrastructure work in practice and also to enable the development of the infrastructure itself. Since integration is very much about creating cooperative activities to enable the building of technical and institutional linkages, it is very appropriate to study it within the framework of social capital. For so doing, we address the following two fold research questions

- 1) How does social capital shape the realization of ICT based HIS efforts in the context of developing countries?*
- 2) What is the role of ICT in building social capital?*

Empirically, the paper draws upon the study of on going efforts of a NGO called HISP India to design, develop and implement integrated HIS in the state of Gujarat in Western India. Specifically, the focus is on understanding the nature and role that social capital plays in the realization of the integration efforts.

The rest of the paper is structured as follows. In the next section, the key concepts around social capital are defined and the manner in which it has been appropriated in the domain of information systems research is discussed, followed by an outline of the research methodology employed and a description of the case study. In the analysis and discussion section that follows, the nature and role of social capital in shaping and being shaped by the integration efforts is analysed. Finally, conclusions are drawn and presented.

2. Social capital and its application in IS research

One of the founders of the concept of social capital, Pierre Bourdieu (1986) defines the term as “the aggregate of the actual or potential resources which are linked to possess of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition”(pp.248). Huysman and Wulf (2004) provides a more elaborate definition, saying: “*Social capital refers to the network ties of goodwill, mutual support, shared languages, shared norms, social trust, and a sense of mutual obligation that people can derive value from. It is understood as the glue that holds together social aggregates such as networks of personal relationships, communities, regions, or even whole nations*” (pp.1). In short they say that: “*Social capital is the value derived from being a member of a society or community. By being a member, people have access to resources that are not available for non-members*” (ibid.). Social capital can thus be seen as an important ingredient for knowledge development within and between organizations (Cohen and Prusak 2001), with also potential negative effects if there is a condition of high dependency on the central actor (Uzzi 1997). Unlike human and financial capital, social capital does not lend itself to quantitative measures. It is a process of embedded and goal-oriented social interaction that leads to potentially constructive outcomes (Bankston, Carl et al. 2002).

In our research what we found more interesting, and which is not given much emphasis in the social capital discourses, is the value derived from being part of multiple network. We used social capital is because of its central focus on “trust” and “relationship” but not much of authority. However, we argue that this trust gained through being part of multiple networks can be the source of power and authority for the institutional entrepreneur who wants to bring change in a particular organization setting. This, in turn, makes us to be cautious when we apply this concept in practice.

Nahapiet and Ghoshal (1998) identified three analytical dimensions of social capital. These are: structural, relational, and cognitive. The structural dimension refers to the overall pattern of connections among actors, who you reach and how. The presence or absence of network ties among or between actors is a key facet of this dimension. When connection and interaction between members of the network gets stronger, other individuals are more likely to be involved. The relational dimension focuses on the particular relations people have, such as mutual respect and friendship, that influence their behaviour. Trust and trustworthiness are key facets of this dimension. The cognitive dimension refers to those resources that provide shared representations, interpretations and systems of meaning among parties.

In recent times, the concept of social capital is introduced in technology studies and information systems research. For instance, Hatzakis, Lycett et al. (2005) used it to evaluate relational computer based change management initiatives. Syjann and Kuutti (2004), in their study of a technology mediated hunting dog breeding community, describe the role of technology to generate and maintain trust, acceptance and alignment which was necessary for building successful cooperation. The use of information technology was described by the authors to make the actions of the key actors more visible to each other, which in turn facilitated the emergence of trust and social capital. In the same vein, of understanding the role of social capital in civic engagement, (Blanchard 2004) explored how participating in virtual community affects social capital in a face-to-face community. Drawing empirical material from a Multiple Sport News Group virtual community, the authors argued how active participation in the group positively affected face-to-face social capital

and norms of trust amongst members in both the virtual and face-to-face groups. As a result and through time, members become less attached and obligated to the virtual community as compared to the face-to-face one.

Emphasising the role of technology for harnessing social capital, Quan-Haase and Wellman (2004) argue that unlike technological determinists who suggest that technology is diminishing or transforming social capital, the Internet is enhancing it. They argued that those who use the Internet also would continue to communicate by phone and through face-to-face encounters. Information technology also can play an important role in knowledge sharing by enabling communication amongst proactive individuals regardless of time and geographic location (Hoof, Ridder et al. 2004). Social capital, it can thus be inferred, is not only developed by group actions or collective norms but is also enabled through individual characteristics such as the eagerness and tendency to share.

In summary, information systems research, which has drawn upon the concept of social capital, has largely been focused on addressing how technology mediated interactions contribute to the development or not of social capital and its various constituting aspects. However, what has not been given adequate attention is the constituting and constituted relation between technology and social capital. This implies the need to understand how technology itself is a function of the existing social capital, and how the interaction between the two reconfigures both the technology and the social capital. This analytical relation is explored in the context of a HIS integration initiative in India.

3. Research approach

This study adopts an action research methodology, where it is framed within an ongoing research initiative aimed at the design, development and implementation of HIS within a public health setting in India. For a period of two years (2007-2009), direct observation of the activities was conducted on the field involving conversations with field personnel on their day-to-day roles and the challenges they face that resulted from a fragmented HIS operation. For example, we periodically met with the head of the health department to understand the challenges he was experiencing due to the fragmented information channels within the reproductive child health programs, and his vision of developing integrated and cross cutting indicators to allow for more effective monitoring.

Semi-structured interviews were used to collect qualitative data pertaining the perspectives, insights, expectations and visions of key stakeholders. Special emphasis was paid to understand the nature of socio-technical challenges to integration, and how the HISP India implementers and users try address them. The key assumption underlying this inquiry was that integration is a complex phenomenon that is deeply embedded in existing technical, institutional and social conditions. This assumption in turn informs the use of open-ended questions, allowing the respondents to give their views on how they see integration and also the nature of their social networks and interactions around the technology initiative.

Gujarat state, the site for the empirical work, is composed of four hierarchically arranged administrative levels: state, region, district and block. Gujarat has 5 regions,

25 districts, with each having 5-7 blocks. Computers were placed at the block level, where the entire data entry and reporting of all the health facilities in the surrounding catchment area took place. From the block, the aggregated data was sent (either online or manually carried in flash drives) to the district, where further aggregation took place in the online application called District Health Information System (DHIS). The region served as an administrative unit responsible each for 5-6 districts, but where no specific HIS related activities took place. While at the region level, the person responsible for reporting is known as the “regional program coordinator” (RPC), at the district level this role is known as “district program coordinator” (DPC). The M&E (Monitoring and Evaluation) Assistant or the Block Health Officer (BHO) was responsible for data collection and reporting at the block.

A series of focused interviews were carried out with staff from the different levels (see Table below), when we visited each of the regions during the period 4-8, August 2008. During each of these visits, the state level team (including ourselves, researchers as well as implementers), made presentations of the new version of the system to the state directors. There was also a training session for the district and block level. During breaks in these meetings, interviews were conducted with some of the district and block staff. Listening to the overall interactions between the state and district/block teams also served as very useful sources of data.

District/Block	No. of respondents
Ghandinagar region	1 RPC
Ghandinagar district	1 DPC
Ghandinagar block	1 M & E assistant
Mansa Block	1 BHO and 1 M & E assistant
Baruch District	1 DPC and 1 M & E assistant
Jamanagar corporation	1 M & E assistant
Surat District	1 DPC
Dagen District	1 DPC
Navasari District	1 DPC
Vododra District	1 DPC
Panchmhal District	1 DPC
Amerli District	1 DPC
Total Respondents	14

Table 1: Number of District and Block respondents

Other sources of data such as email correspondences between state and district teams were used to better understand the specific issues being raised in these conversations. Emails between the HISP India staff also provided valuable primary source information on how they approached to resolve specific challenges. Practical engagement of one of the authors in some of the technical tasks such as cleaning up the problems in report generation and solving software bugs further helped to gain insights to the technical challenges to integration.

The data analysis was shaped largely within an interpretive framework, where different aspects of the nature and implications of social capital and its interaction with the integration initiative were inductively interpreted. All the authors of this paper carried out their respective interpretation and then collectively tried to understand the variations in the interpretations and why. Subsequently, these interpretations were analysed in the backdrop of the theoretical construct of social capital and integration to understand the specificity of the findings with the research phenomenon studied.

4. Research setting

The case is set in the public health system of the state of Gujarat. There are two key actors involved in this research: HISP India, a NGO that was engaged in the design, development and implementation of an integrated HIS for the state; and, the Health department of the state who was the users of the system and the information being generated by the system. Since HISP India was a node in the larger global R&D network established by the University of Oslo, Norway, around HIS (called Health Information Systems Project – HISP) on-going in about 15 different countries in Africa and Asia, they drew upon the expertise offered by Oslo research and masters students to address particular technical problems (such as for optimizing server performance). HISP India also tried to draw upon “social capital” nationally, especially the personal networks of the President of the organization, for example, in getting friends in local software companies to look at the software code or in getting their advise on establishing software testing protocols.

Gujarat is a state on the west coast of India with an estimated population of about 50 million (as per census India, 2001). The state is in the forefront of economic and infrastructure (including e-infrastructure) development in the country, reflected in the fact that nearly all district and sub district level health facilities have computers, and there is internet connectivity available down to the sub district (called block) level. With respect to the organization of primary health care delivery, the state is divided into six sub-national regions, 26 districts, 250 Blocks, 950 Primary Health Centers (PHCs) and 450 Community Health Centers (CHCs). Each PHC has under it about 5-7 Sub Centers (SCs) that are responsible to provide outreach based services to the community.

Generation of health information starts at the SC, which is the first contact point between the community and the primary health care system. Field level male and female nurses are expected to visit the villages assigned to them (one nurse typically is responsible for a catchment population of 5000) for providing various public health related services such as related to deliveries and immunizations. Data generated through this service delivery is first noted in the field diaries, then posted to various registers (typically about 15 to 20 in a SC relating to Malaria, TB, Family Planning,

Antenatal care, Immunization etc.), and finally taken on a monthly basis into the Form 6 which is then sent to the parent PHC for further processing and upward transmission. The health supervisor at the PHC level compiles this Form 6 data together with Form 7, which includes data from the PHC level service delivery, and prepares Form 7A (an aggregate of all SCs and the PHC services) which is then sent to the Block Health Office (BHO). The CHCs in turn compile their service delivery in Form 8 and also send it to the respective BHOs. At the BHOs, Forms 7A and 8 are aggregated to Form 8A and sent to their respective district offices where an aggregated Form 9 is compiled and transmitted to the State office. The schematic below summarizes this rather complex and fragmented information flow.

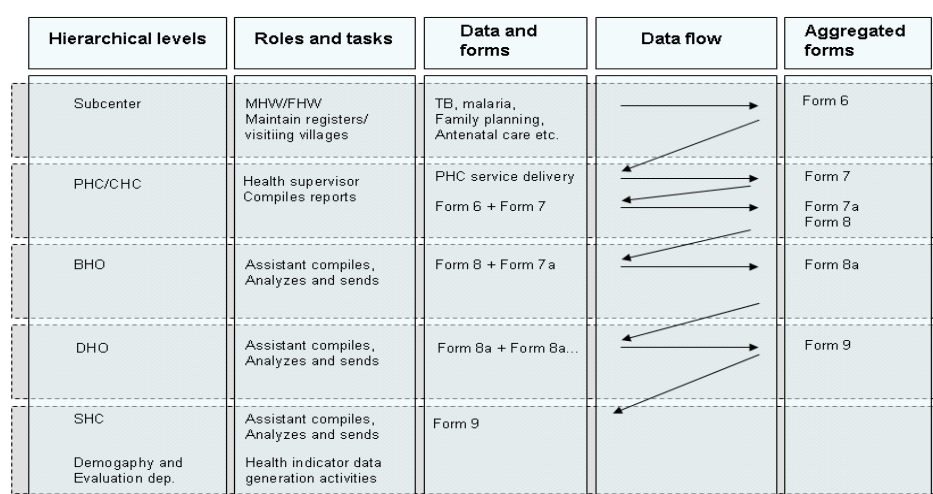


Figure 1: Fragmented information flow in the RCH program

It must be noted that the above schematic is primarily concerned with the RCH program. In the larger picture there are various other programs such as TB, Malaria and Integrated Disease Surveillance Program with their own respective information systems. This was however, not seen as a problem by some, like a district staff who remarked:

It is impossible to mix all the programs since they have their own agenda...what is wrong in working separately. They are working fine and it is very easily to monitor a single program than the whole.

Given this brief contextual background, we now discuss the specific initiative studied.

4.2 Implementation process of the integrated e-HIS

In what can be called as the first phase of the project, in early 2006, HISP India was invited by the State to implement an integrated HIS on a pilot basis at the block level in one district in the state (called Valsad). The notion of integration involved in this phase was taking the data entry forms of the different Reproductive and Child Health (RCH) related activities into one format (Form 6) in order to try and eliminate various

redundancies and duplications. The project involved the deployment of the HIS application –DHIS- at the BHO office computer and training the staff from the different facilities in the block to carry out the basic data entry and reporting activities. Similar processes were also undertaken at the district office. Six months into the process, the project results were evaluated, and happy with the outcome the State Health Commissioner extended the project to four further districts (Rajkot, Surendranagar, Kutch and Baruch). However, in early 2007, for various institutional reasons unknown to HISP, the State terminated the project stating their plan to use another application.

In late 2007, HISP India to Gujarat was recalled by the Health Commissioner as he was unhappy with the application bought in place of the DHIS, especially its weak analysis capabilities such as related to the generation of indicators and their graphical and map-based presentations. In the presentation made when recalled, HISP India emphasized the dashboard facilities of the application, and the value it provided in monitoring both the data quality and health status in the districts. To address the previous unsuccessful implementation of HISP India in the 5 districts, the Commissioner changed the model from a block level deployment to a server based state level deployment arguing that such a “top down” approach would help to develop ownership of the senior state managers who would then be able to provide the impetus for the lower levels of district and block implementation.

In retrospect, this implementation model has in general worked quite well with the district level implementation stabilizing to a large extent within a period of 2-3 months. This involved a server based deployment, which has been the medium for the use of the integrated application. The very fact that all the districts were required to access the same application over the same internet infrastructure required the need to further integrate processes such as related to data entry and technical support. Further, the integrated application placed additional pressure on the performance of the database because of the sheer volume of data that needed to be stored, accessed and processed at one source. The server based application also created the need for developing new kinds of capacities both for the users (who Previously had not worked on an Internet based HIS), and for HISP India for whom it was their first such experience of implementation. Three challenges to integration related to server, database and capacity are now discussed.

4.2.1. Server performance

The DHIS application was deployed on a Windows based server that was rented from a private provider based in North America. The server had a 2 GB RAM, which with time as data started to be entered for a few months became paralyzing slow. The slowness was further magnified by the local Wide Area Network in use in the State, which had an extremely limited bandwidth. These technical constraints coupled with the institutional practice of the monthly data being entered by all the users in the last week of the month, meant that the server was significantly overloaded during this period and also during with the peak working time in the day (10am to 8pm). For example, we tested that importing a file during this peak period and this took nearly 10 to 20 minutes, while outside this period (in the night) the same file could be downloaded in less than a minute. In the interviews and email correspondence conducted, the respondents expressed their disappointment regarding server performance, both while entering data and also in using the export-import

functionality. The following email extract from a District staff to his state in-charge reflects this problem:

Respected Sir,

This is to bring to your kind notice that most District Blocks have completed of Data Entry in Offline DHIS2.0 for April-May-08 Sir. They export the Data by Data Set Wise as advised by HISP India Sir. But when they try to import the same Data to the online application, they are facing problem Sir... We are getting several calls from the Blocks everyday regarding the above problem Sir. Could you please request HISP India to find a solution to the above problem at the earliest Sir.

A DPC from another district summarized his server related problems in an email:

Subject: Problem in DHIS

Respected Sir,

As per your instruction to finish the DHIS entry, we have completed, 40% of entire, but we are facing a lot of problems.

- 1. Server is very slow.*
- 2. Data is not getting saved.*
- 3. Software is not accepting zeros.*
- 4. Software is getting closed automatically.*
- 5. It is taking ½ hrs to save one entry and for the cursor to move to next column.*

Kindly help us in the above mentioned regards so that we can finish the entry as soon as possible.

In addition to the earlier problems of server performance, the 3rd problem related to “not saving zeros” was because HISP India in trying to find a solution of the ever expanding database analyzed the database to identify that nearly 70% of the data included was systematically being reported as “zero” or “blank.”

This was pointed to the state HIS in charge, and it was suggested that we do not store the zero and blank values in the database. While he was not agreeable to this suggestion completely, we were forced to do that to prevent the almost complete paralysis of the server application. Further, it was found that the same user name and password were being shared by multiple users, which magnified the load on the application. To try and work around the slowness of the Internet, some of the users tried to use the Internet from a cybercafé with nearly the same results. The following email reflects this attempt and the outcome from the same:

On Mon, Jun 23, 2008 at 11:28 AM Hello

As discussed on Saturday since there is some problem with the importing process at my end, I tried to do it from cybercafé on Saturday, but it did not happen because the server was too slow. Then I went there yesterday early in the morning and I tried the same procedure again. But the same problem is still there. Now I did it from our computer for two other centers, it is giving the same message like 57% or 100% import process completed. But in the data entry screen, no such data is seen. Please again look in to the matter seriously. May be there is some problem of importing with my username/password.

Since dealing with server related problems was new experience for the HISP India, they tried to draw upon the “social capital” available through the Oslo network of PhD and masters students. Suggestions were made to enhance the server RAM, which was done first from 2 to 4 GB and then to 8 GB. Another suggestion was made to shift the server from a US based provider to one which was local to address the problem of data transfer speed. This was also done to an Indian based provider, whose server was however based in the United Kingdom. While all these measures have greatly helped in enhancing performance, the rapidly expanding database size and number of users continue to prove as challenges to performance. Further measures were worked on including the optimization of the DHIS application, splitting the database and the application part of the DHIS into separate servers, and further moving the server to Gujarat.

4.2.2 Database Size

With time, as first all districts and then block level users started to use the application, the size of the database started to grow exponentially including data for about 8000 organization units. The HISP India team made a systematic analysis of the database, and wrote the following email to the State in charge:

Date: Thursday, August 28, 2008, 4:44 PM

*At the end of every month we have **1,15,30,220** records in the database, of which 78% of data belongs to the Sub Centre (the lowest level of data collection). This 78% of sub- centre data decreases the performance of the application to a great extent. To increase the performance and optimization of the application; we suggest that we maintain 3 to 4 level of data in the online system. But if and when State official want to drill down to PHC or Sub Centre level, data can be made available on request. To do this we need to build a new functionality in the DHIS2 called "Aggregated Export" which aggregates the data to higher level from the field and then exports the data. By keeping the PHC and Sub Centre data at the district or block level, we will be reducing 94% of data load on the server. As and when required by the state official, specific PHC or Sub centre data can be made available for further clarification or scrutiny. This could be achieved by exporting the data in normal (Current) mode. At state office we suggest to maintain one high-end computer (which can act as local server or backup server) where all the data can be stored to easy access and retrieval.*

The above email highlights a policy issue of what level of data should be maintained in the online database. While HISP India were of the firm view that data from the lowest levels (Sub Centre and PHC) should not be kept in the online database (but in a local server) which would reduce the load by more than 90%, the state insisted that they wanted an “integrated database” including all available data. Even the suggestion made by HISP India on not saving zero values was not acceptable, as reflected in the following comment by a district staff:

If we are worried about zeros at this stage in three months, what about the performance of the system in the long run.

The option of using a commercial database like Oracle was also explored by HISP India instead of the existing free MySQL, but the costs and licensing considerations quickly made the state to discard this option. The problem of the database remains still not fully resolved, but temporarily the situation was made under control with the 8 GB RAM servers being able to handle the database load. But as the database size continues to grow, the problem is bound to resurface.

At this stage, the main actor, in HISP India NGO joined National Health System Resource Center (NHSRC-a government of India think tank on technical issues to the Ministry of Health) as a consultant for the HMIS. This enabled the actor to make suggestions on how to improve the existing HIS. One of the core suggestions were on setting essential data sets which serves as standard by bridging the fragmented program owned information flows. Specialists from the public health domain were invited by the consultant to get input in the process. A national level reform process followed in which NHSRC was centrally involved, leading to a dramatic reduction in the number of data elements collected and a simultaneous increase in focus on the generation of indicators.

4.2.3 Capacity limitations

There were capacity issues for both HISP India and the users. For HISP India, both the server and database related issues required a kind of expertise, which did not exist in the current team. To solve them, they drew heavily upon the expertise of the Oslo doctoral students. Further, personal contacts of the HISP India in charge involving friends working in the sever business in private firms in both India and Oslo also helped to diagnose the problem and consider alternative solutions.

From the perspective of the users, many of the issues concerning the online system or the import and export of data were also new. A user from a district commented on their lack of experience in working with an integrated HIS:

In the current situation, we have specialists to manage each program. And I hope they are effective. If we move towards an integrated HIS, then we need to have multi-skilled professionals. That should be the priority focus

Contractual arrangements were set so that HISP India was seen to be responsible only for the development while the State was to take care of the capacity building processes. As a result, no HISP India staff was physically based at the state level. The problem with this arrangement was that the state staff who were responsible for capacity building did not themselves have the expertise to further do the job. To address this problem, HISP India suggested to the state to hire three technical staff for the areas of server, database and programming. But however, due to the prolonged procedures inherent in state recruitment, this suggestion could not be implemented.

In the absence of these physical support mechanisms, HISP India has relied extensively on electronic mail communication, telephone support and periodic visits by their members to the state. The positive aspect of this arrangement was that many of the users were forced to developed skills to be able to work effectively with the application. For example, detailed emails were written by the HISP technical person in Delhi to the state, district and block level staff providing instructions on how to upload a new WAR file containing the upgraded state application.

In summary, we have discussed issues of server performance, database size and capacity needs to serve as key challenges in the implementation of an integrated HIS, which at the present mode is only including the information systems to support the

Reproductive and Child Health program. At the national level, there were on-going attempts to integrate other vertical programs such as related to TB, Malaria, Blindness Control etc. into the HIS. As these reforms are operationalized and transmitted to the state, there will be increasing pressures, technical and institutional, on the integrated HIS.

We now analyse and discuss the case material drawing primarily on the theoretical notion of social capital.

5. Analysis and discussions

Three dimensions of social capital are identified by (Nahapiet and Ghoshal 1998) and presented in section 2 serves as an analytical framework to examine the role of social capital in the implementation of an integrated e-HIS.

Structural: This refers to the overall pattern of connections between the actors involved and the nature of the network ties that exist.

With respect to the case discussed, two aspects of the structural dimension are relevant. One concerns with the top-down implementation model adopted by the Commissioner, which first helped to create visibility of the initiative at the state level, and then the senior state staff themselves took ownership and cultivated the virtues of an integrated system to the lower levels of the district and block. This kind of local ownership, often lacking in HIS implementation projects, helped to create a network of institutionalized relationships and understanding of mutual benefits between the different administrative levels of the health department. The state level saw the benefits with respect to the richer analysis capabilities that an integrated HIS provided, but also realized this required they needed the district level staff to take up the system in an effective manner. This mutual relationship was enabled through the structural top down model of implementation adopted, where the authority carried by the state level was crucial in initiating the process, and then the on-going support and handholding provided to the users helped to cement the mutually beneficial network of ties. This provided the basis for the creation of positive social capital that helped the implementation of the integrated e-HIS.

The second aspect of the structural dimension concerns the relation HISP India has with the health organization. This relation was mediated by the focal actor who was part of three significantly influencing organizations: University of Oslo, HISP NGO and N H S R C. From these organizations, the actor extensively draw upon advices, human and financial resources that helped gain trust from the health sector about the initial implementation in Gujarat and the expansion of the system functionally (e.g. incorporating more health programs in the system other than RH) and geographically (including others states) which contribute the basis for the design of the integrated national HMIS. In general, this ability of the main actor to participate in different networks helped to create mutual trust between HISP India and the health department, with the latter learning to value the expertise, positive intention and objectivity and willingness to support HISP India. Moreover, HISP India is part of a larger “network of actions” (Braa, Monterio et al. 2004) from which it drew upon competency for tackling technical and institutional challenges the company faced

during the integration effort. This kind of partnership and collaboration for learning and experience sharing is suggested by the recent article of (Alsadan, Elmetawly et al. 2015) as a way forward for increasing the adoption of IT in developing country context.

Relational: This focuses on the particular relations people have, including feelings of respect and friendship that influence their behaviour. Right at the outset, the Commissioner valued and respected the expertise that HISP India introduced into the initiative. These feelings were enabled by the fact that the President of HISP India was also a university professor with extensive global experience in field level implementation of HIS projects. Similarly, HISP India held the Commissioner in the highest regard, and valued deeply his vision and focuses of an integrated HIS to support his and the State analysis needs. Gujarat undoubtedly is on the forefront of HIS use in India, and the personal status and visibility of the Commissioner nationally also helped to also provide HISP India with useful mileage in being accepted also by other states.

Outside the state networks, HISP India had strong personal relationships with friends who were working in technical positions in software firms both in India and Oslo. Whenever faced with a difficult technical problem such as optimizing server performance or using alternative databases, the HISP India President would call on his network of friends for advice, problem diagnosis and suggestions of alternative solutions. This very valuable advice was always made available without cost to HISP India who could then implement cost effective solutions without additional financial burden to the state.

Cognitive: This refers to those resources providing shared representations, interpretations and systems of meaning among parties. A key resource in this regard was the use of technology, which while serving as the object of shared representations, also served as a medium to circulate these interpretations. Starting with the server-based application, the medium of deployment for the integrated HIS, helped to focus the attention of hundreds of users to the same application in the “same physical location.” Frequent discussions on problems related to the server performance had the positive effect of creating a common understanding of the issues influencing the integrated HIS implementation state-wide. Common forums (such as of training programs) helped users to discuss similar problems, and also to create user groups who could help each other to find solutions. The use of internet also proved to be very useful for users to directly be able to communicate with the HISP India technical team on the problems they were experiencing and be able to receive advice on how to address them. This direct line of communication was empowering for the users who could now subvert the traditionally existing hierarchical and centralized forms of communication.

6. Conclusion

As argued in this paper, social capital played an important role in the implementation of integrated HIS. As the case study demonstrates, the public sector domain of Gujarat state had a lot to benefit from harnessing the various facets of social capital. The existing

social capital helped the implementation at many levels from enabling the introduction of the initiative to being able to start including other vertical programs and the stabilization of existing systems. On the other hand, the deployment of the integrated application and the use of the Internet helped the creation of additional social capital, such as personal relationships between the district users and the HISP India technical team based on mutual trust and confidence. This helped us to draw two key theoretical inferences. The first concerns the point that social capital is not something given and static, but is a process that grows over time both shaping and being shaped by the processes of implementation. The second concerns the point that ICTs including Internet and the e-HIS itself plays a key role in further building social capital that is helpful to integrate the fragmented HIS. The integrated application provided a common focus and site for people to come together and discuss similar problems and jointly seek and identify solutions. Further, the use of the Internet helped to take these common resources and circulate it across a larger social group enabling the creation of a broader base of social capital.

While, in this paper, we contributed in expanding our understanding of the role of social capital by drawing empirical material, we also contend that it should be taken into consideration in future ICTs implementation in developing countries. As we know, developing countries are suffering from human and financial resources. The most educated part of such nations is not retained in the country, but distributed all over the world. Therefore, the use of an ICT mediated social capital approach shifts our focus to capitalise on the social relation, trust and networking of knowledge people despite their location. Moreover, in this kind of approach, the role of the main leader of such projects becomes more of facilitating and cultivating the trust, which glues together the participants to make the network functional and sustainable. Future research in this area could be identifying the various mechanisms on how to cultivate social relation in ICT projects.

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Paper IV

An Institutional Perspective to Understand FOSS Adoption in Public Sectors: Case Studies in Ethiopia and India

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Abstract This paper is aimed at understanding institutional influences on Free and Open Source Software (FOSS) adoption in public sectors. It explores strategies, policies, and technical infrastructure so as to harness FOSS as an alternative technical solution in organizations such as the health sector. The study was conducted in India/Kerala and Ethiopia following interpretive qualitative research tradition. Data was collected at micro and macro level. While the micro level explored the acceptance of specific FOSS in Kerala and rejection in Ethiopia, the macro level studied how institutions outside the health sector were drawn upon to legitimize decisions. Data collection was conducted while at the same time analyzing and refining the data to find common themes for both settings. Subsequently, the themes were categorized interpretively into regulative, normative and cultural-cognitive institutions as provided by Scott (2001). The result shows regulative and normative institutions influence FOSS adoption in public sectors positively and that integrating FOSS with the proprietary dominated public sector of developing countries should begin by cultivating the normative institutional aspect. The normative aspect focuses on issues related to FOSS education and professional associations. Moreover, the study shows, technology by itself can facilitate its own adoption once it has gained large installed base; expanding the institutional framework to include a technological element. Practically, the study contributes to our understanding of the field level challenges in realizing the potential of FOSS for the benefits of public sector organizations in general and health sectors in particular in developing countries.

Keywords: FOSS, institutional theory, Health Information Systems, public sector, institutional pillars

Cite This Article: Selamawit Molla Mekonnen, and Zegaye Seifu Wubishet, "An institutional Perspective to Understand FOSS Adoption in Public Sectors: Case Studies in Ethiopia and India." *American Journal of Information Systems*, vol. 4, no. 2 (2016): 32-44. doi: 10.12691/ajis-4-2-2.

1. Introduction

Free and Open Source Software (FOSS) is also referred to as F/OSS, FOSS, or FLOSS to mean Free/Libre/Open Source Software. Throughout this paper, we prefer to use the term FOSS as a synonym for the others.

FOSS is a relative novelty within the context of developing countries in general and within their public health sector in particular. The key concept in FOSS is an unrestricted free access to software code, enabling the possibility to study, re-use, redistribute, rework, adapt or improve the programs without being dependent on commercial vendors. It represents a particular strategy to introduce Information and Communication Technologies (ICTs) in developing countries providing the potential to bridge the digital divide without license restriction [1,2,3,4]. It has also potential benefit for African countries to advance their outsourcing industry [5]. The FOSS license facilitates acquisition of software avoiding "the often lengthy and hectic bureaucratic processes, negotiations and associated corruptions apparent in public sector organizations" [6] p.18] of developing countries.

Moreover, there are various other mentioned potential technical advantages arising from issues of system security and interoperability. While FOSS is flexible to respond to the continuous change in organizations, proprietary software are rigid for change [7] once public sectors take ownership of the software. However, realizing these advantages in practice is fraught with various challenges, including those that arise from institutional conditions and capacity, which often tend to favor proprietary software [8,9].

Given that FOSS applications, especially in the contexts of the public health sector in developing countries are in its infancy and surrounded by uncertainty, there are various institutional factors that are used to either enable or constrain its adoption and use. For example, some opponents of FOSS may raise lack of support for FOSS as a basis to reject it in its entirety. The focus of this paper is on understanding how institutions influence decisions to adopt or not FOSS applications. We believe such a line of inquiry is a contribution to IS research in helping to theoretically unpack the institutional shaping of the processes to introduce FOSS. Practically, this analysis contributes to our understanding of the field level challenges in realizing the potential of FOSS for the

benefits of public sector organizations in general and health sectors in particular in developing countries.

More specifically, by doing this study, we seek to contribute to the following two research aims:

- To theoretically understand the constraining and enabling institutions around the adoption of FOSS in public sectors.
- To explore strategies to adopt -FOSS- and seamlessly integrate it with the existing proprietary dominated health care systems through a case analysis involving two developing countries.

The empirical focus of this paper is on the processes surrounding the introduction of the same FOSS based Health Management Information System (known as DHIS2) in India/Kerala and in Ethiopia. While presence of formal institutional mechanisms and support for FOSS in Kerala, India contributed for the acceptance of the DHIS2, the absence of the same, we argue, in Ethiopia contributed to its rejection. This micro level study of the implementation processes is complemented with a broader study in both these countries on the general perceptions and attitudes of key stakeholders towards FOSS and proprietary based systems and by studying the regulative and education systems.

2. Analytical Framework

In order to formulate strategies for applying FOSS based computer systems as an alternative solution for public sectors in general and health organizations in particular, we frame our theoretical perspective around the theory of neo institutionalism. Neo institutionalism emphasizes the analysis of institutional change in addition to stability, with a focus on the role of cognitive-cultural institutions [10]. This perspective is relevant to this paper as we seek to analyze how various institutional mechanisms contribute to institutionalizing proprietary based technological solutions in a particular setting, and to investigate mechanisms to deinstitutionalize or loosen them for creating a “middle way” platform. By “middle way” platform, we mean an institutional environment where both proprietary and FOSS based systems are taken into consideration when choosing a technological solution for public sectors.

In IS studies, institutional theory has been used for analyzing and understanding the impact of institutional pressures on the diffusion of IT innovation, the institutionalization process of software applications and the interaction between IT artifact and existing institutions [11]. However, IS studies are criticized for giving little emphasis on the interplay between the micro and macro institutions [12]. Building on IS studies that used institutional theory for understanding the impact of institutional pressure on IT adoption, we seek to fill this research gap by undertaking a multi-level analysis both at the macro and micro level.

Institutions are rule-rule like frameworks that constrain or enable human actions [10,13]. Institutions are mostly used in relation to stability, with quite few studies employing the notion to study changes (for the later cf. [14,15]). In this study, we used the institutional pillars [10] as an analytical framework to unpack the various institutions that shape the adoption of FOSS in the two

settings contributing to literature that intends to understand how to bring about change in highly institutionalized environment like the public sector. The analytical framework is discussed below.

2.1. Institutional Pillars/Elements

We use the concept of institutional pillars (elements)-regulative, normative and cognitive-cultural [10] as an instrument to understand the various institutions that influenced FOSS adoption. Those are briefly discussed below.

2.1.1. Regulative Institutions

Regulative institutions are those institutions that constrain and regularize behavior. They give importance to explicit regulatory processes such as rule setting, monitoring and sanctioning activities. Regulative Institutions are described as formal institutions as they are explicitly stated and there is a written point of reference in case of disagreement [13]. The primary mechanism of control is coercion and the expected response to regulative institutions is conformity [10] which gives a sense of I have to respond to coercive institutions [16]. The indicators for regulative institutions, as described in [10] are rules, laws and sanctions, which are used as an instrument for implementing and sustaining a technological solution or other practices.

2.1.2. Normative Institutions

As the name indicates, the chief concern of normative institutions is upholding values and norms. While values are related to the principles that are constructed to guide a certain behavior, norms specify how things should be to achieve defined goals and objectives. The mechanism for such systems is normative and the indicators are certifications and accreditation. While the underlying basis of legitimacy is moral governance, the basis for compiling to normative pressure is social or professional obligation. The logic for normative institutions is appropriateness [10]-as I ought to respond to normative pressures because it is morally right to do so [16].

2.1.3. Cultural-cognitive Institutions

The cultural-cognitive institutions emphasize the cognitive dimension of human existence that constitutes the nature of social reality and the frame through which meaning is constructed. While cognitive-cultural is about the construction of common meanings embedded in social routines, the normative gives relevance to social obligation and binding expectations, specified by standards or industry policies [17]. The behavioral reasoning towards change or continuing same institutional practice would be the feeling of I want to [16]. Although institutions are the byproducts of individuals' cognitions, institutional studies have given little attention to the cognitive part of those individuals and how that influence change processes in organizations [18]. By exploring the perceptions of individuals towards FOSS, in this paper, we tried to understand how the surrounding institutions shaped their perceptions.

Previously, this analytical framework was used to study the adoption and diffusion of cross-cultural inter-organizational information systems for financial transaction [19]. The

authors found out that the rate of IT innovation adoption in Europe was high because of the strong presence of the three institutional pillars in Europe than in Taiwan. In the same vein, in this study, we argue the interplay of these three to provide legitimacy for acceptance or rejection of FOSS. Therefore, there is a need to study these institutions within and outside the health sector for bringing about institutional change that is sought to facilitate FOSS adoption. Institutional change constitutes deinstitutionalization and re-institutionalization [20]. Deinstitutionalization “takes place when established meanings and action in an organization are discredited, either as a result of competing meanings and actions or because they are seen as failing to contribute to the institutional existence” [[21] p.37]. Re-institutionalization represents an exit from one institutionalization and entry into another institutional form, organized around different principles or rules [20]. Political, functional and social pressures, both within and beyond organizations, are conditions for causing deinstitutionalization [22]. In addition, others suggest conflicting institutional logics during the introduction of IT in health public sector to stimulate change in institutions by providing room for understanding the pertinent institutions that hinder or facilitate the introduction [15].

Information systems research recommends a cultivation approach for deinstitutionalization. Cultivation is a concept, which is operationalized by implementers through sensitivity to the institutional environment, learning from past experiences [23], following a small step incremental change [24,25] and understanding change as a process [26]. The cultivation approach requires the act of institutional entrepreneurs to identify constraining and enabling institutions so as to bring about change in a highly institutionalized environment. The notion of institutional entrepreneurs refers to “the activities of actors who have interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones” [[27] p. 657]. Hence, institutional entrepreneurs are “those actors whom the responsibility for new or changed institutions is attributed” [[28] p. 1]. Next, we will present the research approach.

3. Research Approach

This is a qualitative research with a primarily interpretive stance to help us understand the phenomena under study through the meanings that people ascribe to them [29,30,31,32,33]. It has also elements of critical stance. The central idea in critical perspective is that “everything possesses unfulfilled potentiality, and human beings by recognizing these possibilities, can act to change their material and social circumstances. And this potentiality for acting to change is constrained by prevailing economic, political and cultural dominations” [[31] p.19]. Therefore, critical researchers argue that phenomenon cannot be understood just by asking participants as done within interpretivist traditions but also by being critical to existing status quo, which constrains the action of the human agency to bring about change [32]. Therefore, the researchers either initiate change as part of action research or they play role in highlighting the constraining and enabling factors for change initiators.

In IS, such studies “are aimed at producing and understanding the context of information system, and the process whereby the information system influences and is influenced by the context [[29] p. 4-5]. We started the empirical work with the assumption that there exist social, cultural and political constructions of institutionalized perceptions around why certain technological solutions have evolved to become de facto standards. Replacing or changing them requires the active use of strategies for de-institutionalization of constructed shared assumptions and other institutions. By examining the national policies, strategies and human capacity, our intention was to explore the link between macro level institutions and organizational tendencies to adopt FOSS.

The case is built upon two sub cases from Ethiopia and India. We believed taking two cases provide rich insights into the various institutional constraints both at macro and micro-levels. At the macro-level, the two contexts provide a study of contrasts where India is known as software outsourcing destination, while Ethiopia is little known in this regard globally. Various states in India have been proactive with respect to policy pronouncements of FOSS while little movement in this regard is seen in Ethiopia. Thus, we felt that the different institutions in the two countries would be the source for varying perceptions with respect to FOSS and proprietary software, and thus with different implications for the micro level implementation efforts. At the micro-level, the focus was the attempts to introduce the same DHIS2 software within the framework of the Health Information Systems Project [34] in the two countries, ongoing nearly simultaneously. HISP is a global network, which has the main node in the University of Oslo and has been engaged in developing and implementing the DHIS2 mainly for developing countries to digitize the routine health data. The network constitutes organizations and individuals that have expertise in health, software development, and organizational issues. The main objective of the program is to make information generated during health care provision to be used for action and planning through the use of FOSS based IT solution. DHIS is a java based FOSS product, which is database and platform independent and have been used in more than 30¹ countries including at the level of nongovernmental organizations.

Data were gathered through fieldworks within a focused period between April to August 2007 and throughout 2015. HISP was running in Ethiopia from 2003-2008 and the researchers participated in introducing the DHIS2 to in the health sector before and in response to the tender for national electronic health management information systems. In Kerala, we generated most of the data using interviews. We got in contact with relevant stakeholders through HISP India members who were working in this organization. Our role in HISP Kerala action research was closer to what would call an “outside observant” [35]. The first author is an active member of the HISP action research and has been involved in the recent pilot testing of the FOSS based DHIS2 in Ethiopia. This involvement generates observation data, which is used to explore the current software adoption in Ethiopian public health sector. The researcher was specifically involved in customization of the software. In this process,

¹ <https://www.dhis2.org/inaction>.

the researcher was able to examine how the stable software governance structure of HISP and the expanded use of DHIS2 in many organizations may have influenced its acceptance for pilot testing.

The second author was involved as an action researcher during the phase in which Ethiopia rejected DHIS2. The second author was also a teaching staff in one of the universities in Ethiopia, which enabled him access data regarding supportive structure for FOSS in the education sector. Documents analyses and email correspondences with relevant informants were also conducted to explore the shift of policy in both settings and its implication to FOSS adoption in health organizations.

3.1. Data Collection Techniques

Interview data and other secondary sources were used as data collection techniques. Data was primarily collected through semi-structured interviews, and supplemented through the study of a vast variety of secondary materials such as policy documents, tender announcements, university curriculum, company brochures, and other related materials. Interviews were conducted with respondents drawn from various sectors including FOSS advocates, academic institutions, software developers, health organizations, and concerned government ministries and users (see table below for a summary of our respondents). The rationale for the selection of these respondents was their importance in the shaping of stakeholder perceptions and capacity towards FOSS and proprietary systems. For example, meetings with university staff helped to understand the emphasis given to FOSS in the informatics curriculum, which was felt to be an important mechanism for shaping the views of students towards these new technologies. Similarly, discussions with private sector software developers helped us to understand the various business models employed by firms to promote FOSS and how those are compared with proprietary systems. Overall, understanding these broader views, we believed would provide us richer analytical insights into the micro-level dynamics of the DHIS2 introduction in the two settings. The following table depicts the representation of respondents in both countries.

Table 1. Number of Respondents in India and Ethiopia

Ethiopia	
Organizations	No. of respondents
Ministry of Health and its consultants	4
ICT development Agency	2
Ethiopian Free and Open Source Network (EFOSNet)	3
Developers in the Health Information System Program in Ethiopia (HISP Ethiopia)	6*
Software Development Companies	2
Addis Ababa University (AAU) staffs	3
Subtotal	20
India	
Kerala Health Department	1
Academic institution (IIIT)	1
Different Software Developing Companies	8(1 from each)
Total Service Providers	4
Developers in the Health Information System Program in India (HISP India)	5
Subtotal	22
Grand total	42

* Three of the respondents were consulted using online chat.

In terms of operational details, interviews were mostly conducted on site, in the premises of the respondent. Typically, depending on time availability of the respondent, an interview would last from 30 minutes to 1 ½ hours. Both authors of this paper conducted interviews. Typically, the meeting started with us asking about the background of the respondents, their job responsibilities, their general views about FOSS/Proprietary software, and the respective challenges they have seen. The questions were deliberately kept open to enable the respondent talk freely about issues they considered relevant. However, with respect to the micro-level analysis, we were particularly focused around asking questions about the introduction of DHIS2, and what were the underlying reasons. This helped to interpret what kinds of perceptions were being brought into the discursive practices, and their role in legitimizing decisions. In both settings, the researchers asked questions and clarifications and extensive hand written notes were taken. The second author had re-written the notes in MS word; already making his own interpretations of the views of the interviewees, which was later, compared and complemented with the first author's hand written notes.

Document analysis was done on various sources such as curriculums of universities, software evaluation criteria applied by the health care managers in the two countries with respect to software selections. For example, the curriculum of technology related studies in one of the public universities was examined to understand the emphasis given to FOSS. Observations were also conducted in the computer laboratories and firms to get a sense of the workplace dynamics in different setting such as private firms in Kerala and public health care setting in both the countries.

3.2. Data Analysis

Data collection and analysis went hand-in-hand through an iterative process as two stages process of data constructions. Van Maanen (as cited in [35]) describes the two stage process involves first-order construction by the interviewees about the phenomenon and second-order data construction of the researcher based on the first-order construction and using conceptual approaches (p. 75). The first-order data were constructed from interview results. As briefly mentioned above the data analysis started while collecting data giving us possibilities to ask other respondents on areas we noticed more clarifications. A thick description (ibid.) of the case was constructed for each setting primarily from the interview data and they were supplemented by other sources. These first-order constructs were studied independently and together to find recurrent themes or issues and grasp the whole picture of the phenomenon. Then, the data from the two settings were merged and the researchers interpretively categorized them into macro and micro level issues; which was further categorized into "meaning units" [36]. "Meaning units" is described as "part of the data that even if standing out of context, would communicate sufficient information to provide a piece of meaning to the reader" [36] p. 153]. The case description was prepared using those meaning units by reducing redundancies and shortening the data into meaningful contracts of the researchers.

The second-order construction of data was performed, when the authors tried to make sense of the first-order data using concepts from institutional theory. Theories are used as sensitizing device so as we as researchers could expose the restrictive conditions of the status quo [37]. Meaning units from the previous constructs were categorized under the three institutional pillars and their implications to the adoption of DHIS2 were studied and analyzed. While doing this, we noticed that there was another institutional element, which could hinder and facilitate FOSS adoption. We recognized this fourth element as “technological element” and discussed and presented how these could be related to the adoption or rejection of DHIS2.

4. Case Description

The case study is structured in two main sections. The first section focuses on the macro level of the institutions we recognized to exist around FOSS and proprietary systems in the contexts of Ethiopia and Kerala respectively. The second section focuses on the micro-level, wherein we analyze the process of decision making around the introduction of the same FOSS application (DHIS2) in the respective health care settings in the two countries. In explicating this process, we seek to understand the kinds of institutional mechanisms that were drawn upon in taking and legitimizing decisions to reject the FOSS in one case, and how the same seemed to have been relatively deinstitutionalized in the other case.

4.1. Macro-Level: External Institutional Influences

In this section, we examine institutions related to policy, capacity and perception in the wider contextual settings of health care organizations in Kerala and Ethiopia.

4.1.1. Policy and FOSS Organizations Related Issues

In Ethiopia, the policy related institutions could be described as a “chicken and egg” situation where the lack of proactivity of the policy making body was attributed to the weak demand from the public sectors, who in turn felt they needed a policy framework in the first place to enable experimentation with these new technologies. The former Ethiopian Information and Communication Technology Development Agency (EICTDA), which was established in 2002, had the national mandate of formulating ICT policy, evaluating and monitoring ICT projects, developing frameworks for guiding the different public sectors including health. With respect to FOSS, a respondent in the agency said “*in our current policies and future strategies there is nothing about OSS but this doesn't mean that it cannot be modified.*” In further discussing the issue, we understood that there was an implicit view that adequate demand has not yet come from the user departments for modification, creating this “chicken and egg” situation. Recently, this organization is restructured and named Ministry of Communication and Information Technology (MCIT), established in 2010 and have the same mandate as the former EICTDA. We found comforting slight appropriation of both FOSS and proprietary solutions as one of the strategies for e-government solutions in the national ICT policy document.

It is described as “*adopt and implement an open policy for use of proprietary, free and/open source software systems in developing e-government solutions*” (MCIT, 2009).

Potentially, in Ethiopia, there could be other actors in the future who could influence and break the deadlock of this existing chicken and egg situation. A key actor in this context is the Ethiopian Free and Open Source Software network (EFOSSNet), a non-governmental organization established by a group of interested individuals with the mission of carrying out research and development activities related to FOSS. EFOSSNet had specific initiatives to build awareness about FOSS, which is believed to positively contribute to the introduction of FOSS to the public sector in the country. They were also involved with advocacy efforts with the government. An informant from the organization believed that in the long run there was no other option for developing countries like Ethiopia other than going FOSS route. However, as we saw in the case of the health care setting, the impact of advocacy of this group on policy was rather limited.

Another view at the policy level in Ethiopia was the assumption that development agenda of the country was only possible to be furthered by multinational companies. A senior higher official at the policy-making level argued as follows:

Fast social development was possible only by relating to big multinational companies, and it is not good to go against the storm. Microsoft and other proprietary businesses are currently dominant, and so why should health sector take the risk of going otherwise?

In contrast to Ethiopia, in Kerala, India, there were various formal policy related institutions that had been established to actively promote the adoption of FOSS in the state. While Kerala had a relatively high level usage of proprietary systems, although lower than the nearby states of Karnataka and Andhra Pradesh, the intention of the government to actively promote FOSS was evident. The state had formulated specific policy of supporting, using, and promoting FOSS systems in all public institutions, with ambitions as described by some to make it “God’s own e-state.” The Kerala State IT Mission, a governmental organization established to foster the process of IT adoption in general and FOSS in particular, had various initiatives to support policy implementation such as through training, the creation of manuals and other instruments.

Further, policy implementation support in Kerala for FOSS came through 5 semi-governmental institutions, referred to as Total Service Providers (TSPs), established with the objective of promoting alternative computing under the framework of Free, Libre and Open Source Software (FLOSS). They claimed to help the benefits of ICTs reach larger section of society, as well as to promote employment and development through FLOSS. They developed software for different organizations in the public sector and were also expected to support the implementation processes.

4.1.2. Capacity and Expertise around FOSS

Higher education institutions play a key role in shaping perceptions, attitudes and capacities towards new technologies and approaches. In Ethiopia, the educational condition with respect to FOSS was one of passivity. In one of the oldest and most reputable academic institution, the graduates with software/information systems education

were not well exposed to FOSS paradigm. By studying some of the curriculum, and talking to and observing students at work in laboratories, we inferred a general lack of awareness towards FOSS and related technologies, and a distinct affinity towards Microsoft technologies. This also reflected by the fact that there is not significant contribution to open source projects from Ethiopia. We attributed this partly to the education system and the consequent job market, which is not taking equal emphasis for both types of technological solutions and partly to the infrastructural challenge-internet and power supply.

The shortage of FOSS skilled professionals in the market further contributed to the dominance of the proprietary based businesses. In contrast in India, where the software industry was booming on a global scale, there were private and public colleges offering courses also in FOSS based technologies to meet the industry demand. However, the demand for FOSS developers in the public sector was found to be poor. The situation was made worse by the strong private sector, which lured away people with expertise in FOSS technologies (like Java) based on high salaries, which the government sector could not match and making them focus on proprietary solutions. A developer in India said:

This reality affects the expansion of FOSS and if organizations go for it, they will suffer shortage of qualified professional. In my former institution, we had a FOSS program, which was used to train our own staff on it. But since the market was luring, qualified people frequently left that institution, and the attrition rate was high. Only few that were committed remained.

Respondents often cited the low level of awareness towards FOSS in the public sector as a reason for the slow uptake of FOSS applications. The mindset of decision makers were described as: *“those at the decision making level, whenever they think of a computer based system, they think of proprietary software companies.”* The situation on the ground where there was a monopoly of Microsoft products and skills only related to its use, dictated the use of proprietary systems, making it hard to go for FOSS. The counter argument to the lack of capacity for FOSS made by technical people in both countries was that training is part of a normal system development process, be it FOSS or proprietary. Therefore, if there is no demand for FOSS products, there is no development and that it will not be easy to find expertise in FOSS related technologies. In relation to this, technical people argued that it was not difficult to get used to the FOSS habit, and *“it was easy to get used to new systems very fast”*, but there should be demand from the public sectors first.

On the other hand decision makers complained about the poor help desk support and reference points of FOSS products to resolve technical problems. Some software company managers in India complained on the absence of technical support that *“No one is to be hold accountable for failures and troubles, and also that you will not get everything in a packaged form”*. The technical people countered the claim by attesting that one could get such support online for FOSS, at the fastest possible speed, and even much better than in the case of proprietary systems. One Indian FOSS programmer also stressed that depending on the demand of the system, it was possible to get all required help.

4.1.3. Business Models and Cost Effectiveness of FOSS

In Kerala, an interesting contrast with respect to Ethiopia concerned the presence of many private sector software companies who were building feasible business models around FOSS products and services. However, as contrasted to “pure” FOSS models, these companies gave the source code only to the specific client, be it a government organization or private business, which then did not have the right to distribute or sell the code, depending on the agreement.

Given that firms in Kerala had for the last few years been engaged with the development of FOSS applications, they saw public sector settings, for example in health, to provide a rich potential business domain. They had thus developed sharp cost related arguments about the advantages of FOSS over proprietary systems. For example, the CEO of an open source software development company in Kerala noted:

In such countries applications for health institutions can be developed by amateur programmers for a reasonable cost or smaller software companies can offer them for a bearable cost. However the supporting platform, systems have to be bought from big multinational companies for huge amounts and with escalating cost as distribution increases. Such infrastructure related costs are really discouraging for public health institutions where there are hundreds of regional and district level branches.

A researcher and lecturer at a technology related educational college in Kerala stressed that the TCO (Total Cost of Ownership), when it comes to FOSS, was very small. Another software development company manager recalled that, *“some public institutions do spend a great deal of money for proprietary systems and yet they fail; and others abandon computerization due to absence of the required money.”* Such respondents believed that FOSS products have cost advantage to public sectors. However, counter arguments with respect to costs were put forth by firms dealing with proprietary software. Another manager of such a firm in Kerala, said:

Many people acknowledges getting source code to be an advantage but the thing is who can understand what is written by others...it is just like trying to finish a fiction written by another author...do you think it is possible to do that?...trying this requires high cost....it is very much cost effective to start from scratch.

Related to cost, maintenance issues were raised as important factors for the adoption of FOSS. Firms dealing with FOSS argued that closed source systems required access to the source code for responding to maintenance needs and changing requirements. So it created a lock-in situation with the vendor who always needed to be there for help, always involving additional costs. This dependency, according to a faculty member, often built tensions into the contract, where the vendor claimed that the contract was over while the client demanded more needs to be incorporated. Such tensions were potentially avoided in FOSS; where the source code was available free. However, few respondents countered that FOSS was never for free, and there were always costs involved related to training, maintenance and upgrades. A member of FOSS association rationalized that costs were always involved, be it proprietary or FOSS but the issue is what is most costly especially for maintenance.

We also heard some moral arguments about the cost effectiveness of FOSS, that public money being spent by public sectors, such as in health should, be used righteously. One respondent in India said:

Government owned health systems get their fund from taxpayers or from donors that are meant to help solve different critical health problems. If the money that could have been used to alleviate serious health problems is invested in the supporting health information systems, given that there is other alternative, it will be unfair to the best and unjust to the worst. The only way to make sure that public money is properly used is using FOSS approach.

4.1.4. Licensing and Availability of Source Code

Regarding license, almost all respondents from both countries revealed that organizations or individuals in many developing countries do use pirated systems; else it would be nearly impossible to develop applications given the prohibitive licensing costs of proprietary systems. However, we did not find respondents being concerned regarding the use of pirated copies in public sectors. They rather thought it was fair to use pirate copies in the framework of social justice.

Access to source code was seen especially crucial to public sectors like health, where the requirements were seen to be dynamic. However, many respondents, especially in Ethiopia argued that the availability of source code became irrelevant without adequate support and documentations. On the other hand, software developers perceived access to source code as necessary means to build internal capacity, gain self-reliance, avoid lock-in problems (when a single supplier would manipulate them in a way they wanted). They also appreciated the possibility of modifying the source code internally to address changing requirements. Access to source code was also seen by some to be crucial to enable interoperability of systems. An official from Ethiopia indicated:

If all health institutions use OSS, information exchange and interoperability will be simple.....especially public health institutions in developing countries who are getting to be part of e-governance systems. They are better off following open standards for better data sharing.

However, access to source code was also mentioned to compromise patient security and privacy in the health sector, which was countered by proponents. The counter argument was that FOSS provides more security technologically, as it allows users to add their own security mechanisms, and not be dependent on what was provided by vendors.

4.2. Micro level: Decision making around the adoption of DHIS

Our specific focus in this section is on describing the decision making process of the same FOSS based DHIS2 in the two empirical settings.

4.2.1. DHIS2 in Ethiopia

The Ministry of Health is the highest authority nationally, endowed with powers and responsibilities to expand health services and provide care to the broader population, especially to the disadvantaged segments of society. There are 11 regional bureaus that report to MOH.

Although the regions have a fair degree of autonomy, the decision of the regions is influenced by MOH including one related to technological choices.

Albeit in its early development stage, DHIS2 was presented to MOH in 2007/2008 for consideration as a national monitoring and evaluation tool. The value proposition was that such a system would help streamline health information systems and also would contribute to develop capacity within the country.

The first interesting aspect of the decision making process was the tendering process in which the criteria for applying were stipulated. It was stated that a preference would be given to MS based platform. Specifically, the tender document said:

FMOH has a preference for Microsoft Visual Basic / dotNet (commercial, with free distribution for standalone installations)

At the end of the evaluation, MOH decision was to reject DHIS2 because of two key reasons. First, DHIS2 did not meet the functional requirements of the MOH, and second the HISP team did not have adequate professional capacity to provide sustainable support. The letter received explicitly stated:

It is essential that the FMOH own the HMIS software. The DHIS software source code is publicly available; however ownership means more than access to source code. Practically speaking, ownership means that the FMOH needs access to software developers with the experience needed to modify the source code. There is no evidence that the skills to modify the source code are readily available in Ethiopia.

In response, the HISP team wrote to the MOH that with respect to functional requirements, it was an incorrect argument since they were never formally provided with the requirements. While acknowledging that their software currently was in the process of development, HISP argued that software development was a process, which necessarily needs to evolve through a process of mutual interaction between development and use. They thus needed to be given this opportunity of mutual interaction so that capacity within the country will be developed through the process. Further, HISP strongly refuted the claim of their lack of technical capacity, arguing that:

Capacity is never a given for any kind of technology or application but needs to be cultivated and nurtured in close collaboration between the user and development communities. Here again we would like to argue that we have both strong exiting capacity and a solid basis for its evolution and growth in the future shape by the needs of the health services.

Based on this letter and a subsequent meeting with officials, another opportunity was given to HISP to present their software. A new and much improved version of DHIS2 was then presented, which again was rejected by the MOH, who in their letter emphasized the technical functionality and the lack of human resource capacity as shortcomings to adopt the software.

Through this letter, HISP was formally informed that the DHIS2 had been rejected, and they should with immediate effect stop all development work. A copy of the letter was also sent to the regional health bureaus that HISP should no longer be active. Subsequently, while interviewing respondents about the relevance of FOSS more generally in Ethiopia, the respondent argued that

FOSS was not relevant to Ethiopia because of the lack of existing technical capacity in this regard. The respondent said: *“Most of the developers in Ethiopia do not know FOSS technologies and it is difficult for us to go for it”*. When we pointed out to the same respondent the argument of FOSS to provide the health department with the ownership of the source code, which enables them to continuously modify the software to meet their changing requirements, the respondent countered:

The responsibility of the MOH is to provide sustainable and effective health care. Why should they be concerned about software?.....usually it is not easily to understand what is written by others...so the question is is it cheaper to start from scratch?...may be it is.

By this, the MOH went on employing another donor funded software company to develop the needed software from scratch than building what was started. However, we found the problem to revolve around the low awareness level of FOSS products and began to assess the various institutions that may be relevant to make FOSS products alternative solutions in the public sector of the country. Those were presented in the previous section. On another note, currently, MOH is pilot testing DHIS2.0 as the existing software is not responding to the needs of the health sector.

4.2.2. DHIS2 in Kerala

Kerala is a state in the southwestern India, with an estimated population of 32 million, which is close to half of the whole Ethiopian population. Relevant to our analysis, the following features of the state were pertinent:

- A history of communist governments whose anti-imperialist stance made them strongly anti-proprietary software and pro free software.
- A new Left government was voted into power in 2005, which explicitly made free software use as a formal government policy.
- The state has a history of strong community based involvement in various sectors including in public health, thus encouraging the need for grass root level workers to take control of their own information processing needs amongst other things.

The HISP initiative had started in India in 2000. Initially, HISP approached the health department of the Kerala state and proposed them a pilot project in one clinic, and permission was accorded to them. Six months on, as promising results were seen, HISP approached the health department again to extend the project to the whole district. Around the same time the very first version of the DHIS2 was released. HISP offered to buy 17 computers and facilitate this extension process, and since the state department saw no financial costs to them and that HISP had shown promise in their initial efforts, the permission was provided, and the first version of DHIS2 was deployed in 19 Block level clinics.

However, as this phase of the HISP effort started, they came to know the existence of a competing health management information system project going on through a large government owned computer firm that had previously been responsible for the development of the first supercomputer in the country. This project was funded through the European Commission, and was proposed to be built using a mainframe based architecture where there would be one application running and online

use of the system would be carried out through the district level. This application was built on a proprietary platform involving Oracle as the database and Visual Basic as the development language. The view of the implementers was that a centralized architecture was needed because the field level users were not ready for computerization, and the maintenance overheads were tremendous. The HISP model was completely in contrast for various reasons. Firstly, it was built completely on free software. Secondly, the implementation model focused primarily on the grass root level, where the field users were seen to be the most important users of information, and thus it was their capacity, which needed to be developed. And historically, the field level and bottom up implementation model was one, which very much historically inscribed the HISP philosophy as it had taken root in 1994 post-apartheid South Africa (Braa and Hedberg, 2002; Braa and Sahay, 2012).

As both projects were ongoing, and threatening to conflict with each other, the state authorities needed to take a decision on which project should be continued. Both parties were called for a formal evaluation, which was presided by the key decision maker of the state health department. During the evaluation, the government firm sketched out their model of implementation in which they argued for a centralized model. HISP in their evaluation emphasized its approach based on FOSS which they pointed out was supporting the state government policy of promoting the use of FOSS. They also emphasized that their model is empowering the field workers, and indeed they were very capable of running the system and meeting their information processing needs. As evidence, they showed a set of reports for the current month that had been generated by the field staff in the pilot sites they had been working in. This demonstration was well received by the health department, as again it resonated with the left government agenda of promoting grass root level democracy. Furthermore, HISP elaborated on the global HISP network, the expertise available, and how the software would be continuously upgraded and global best practices incorporated.

Table 2. Comparing Kerala and Ethiopia at Macro and Micro level

Macro	
Ethiopia	Kerela
Weak policy support to FOSS	Strong policy support
Weak awareness and support that is exacerbated by the poor information technology infrastructures	Strong political commitment and support for FOSS
Weak FOSS professional association and other advocacy groups	Multiple governmental and non governmental organization promote FOSS
IT and Information systems courses favor proprietary software	FOSS is covered equally in the education systems
Shortage of FOSS skilled professionals	FOSS skilled professionals are available but inadequate
Conflicting views regarding the cost advantage, maintenance and governance issues of FOSS	Conflicting views regarding the cost advantage, maintenance and governance issues of FOSS
Micro	
Ethiopia	Kerala
- Rejected DHIS in 2007	The health department accepted DHIS2 in 2000 and worked with HISP to adapt and extend it to their needs
- In the process of adopting DHIS in 2015 after the software becomes stable and matured	

Based on these presentations, HISP was evaluated over the government company, which was extremely large, well endowed with resources, and were supported through the formal machinery of the EU. In contrast, HISP was a small NGO, supported through university research funds, and with very limited resources. Currently, HISP is not supporting the DHIS2 software in Kerala. The state health department has taken the responsibility of maintaining and running the software by themselves after getting several years of support from HISP. The table (Table 2) presents a comparison of the various issues that influence FOSS adoptions in the two settings.

5. Analysis

In this section, we analyze the empirical data provided in the previous section using the analytical framework presented in section 2. In this analysis, we identified the various institutions from the wider context in which the health care sector is situated in to highlight their enabling and constraining role to the adoption of DHIS2.

5.1. The Regulative Institutions (have to)

The regulative institutions in this context include the ICT policies and the official tender documents that sanctioned or support FOSS based systems in the two settings, which are actively drawn upon to “cultivate a belief in the legitimacy” of one or the other [10]. These institutions can be coercive by nature and conforming to them is rewarding, while non-conformity can lead to sanctions and rejection.

In Ethiopia, the former EICTDA the organization responsible for ICT policy formulation for the public sector, created a draft policy, which reflected a bias towards proprietary software, and a consequent marginalization of FOSS. FOSS was not mentioned as an alternative technological solution for the public sector in the policy drafted in 2005. However, in our recent examination of the Ethiopian ICT policy document, we found that bias to be slightly corrected by presenting an enabling environment for both proprietary and FOSS as alternative technological e-government solutions. This gives a positive implication to the change of institutions by defining a fair environment for both technologies. Some individuals felt the regulative institutions to be constraining them from going in FOSS direction.

Another regulative institution that constrained the use of FOSS in Ethiopia was the tender document; which again was influenced by the old ICT policy. This institutional element was reflected and also drawn upon by the MOH evaluation criteria in tender document in which explicitly MS products were stipulated as the preferred choice of the MOH for building the national HMIS. In contrast, in Kerala, the policy environment, influenced by historical and political reasons, clearly favored FOSS. Consequently, at the micro level, while the presence of such regulative institution facilitated the acceptance of DHIS in Kerala, the lack of similar institutions in Ethiopia led to the rejection of the same software in the Ethiopian health care sector. This finding is consistent with the recent findings in [19] that attributed the low diffusion of Straight-Through-Processing (STP)- a type of inter organizational system in the financial industry- to the

loose regulative mechanisms in Taiwan. The authors further claimed that the presence of such regulative pressure facilitated the uptake of the same technological solution in Europe. In the same vein, IS researchers have found out top-down approaches to be more successful when it comes to digital infrastructure evolution [38] that includes adoption and diffusion. Regulative institutions as a topic of the top-level management need to be compatible with the nature and approaches of FOSS if they have to be adopted. The case demonstrated two opposite regulative institutions in Kerala and Ethiopia. While the Ethiopian regulations enable proprietary software, the Kerala regulations enable FOSS.

5.2. The Normative Institutions (ought to)

The normative institutions include those institutions that provide principles and guidance regarding the ideology, use, methods, and technological frameworks for FOSS that create appropriateness for its use in organizations. Organizations that are engaged in setting the normative institutions in practice include the formal education sectors, training facilities, and professional association. While the presence of normative institutions for FOSS facilitates adoption, the absence of such institutional mechanisms hinders its adoption and further diffusion.

In Ethiopia, the bias towards proprietary software was reinforced by the nature of the informatics curriculum in the national university where FOSS technologies did not find a prominent place. Microsoft products were seen to have become “part of the furniture” [39], and limited alternative voices existed to challenge this status quo and create any form of political or functional pressure [22]. In India, while the Oslo university staff and students through HISP could serve for professionalizing the FOSS concept in the public sector, the same potential could not be created in Ethiopia. In addition, the education system, in Ethiopia, has not provided any strong enabling institutions, which could provide guidance and principles in the use of FOSS.

Further contributing to creating positive environment for FOSS and thereby facilitating the adoption of FOSS in Kerala was the presence of a professional organ called TPSs. These organs were actively developing and promoting working business models around FOSS use in the public sector. Furthermore, in Kerala, the university-based model of HISP was seen positively as it was associated with enabling the circulation of new knowledge and global best practices. In contrast, private companies in Ethiopia created a normative pressure for the use of proprietary based systems. That was further reflected clearly in the evaluation result of the MOH, where the lack of private firms providing FOSS expertise was taken as a basis to reject DHIS2. The only enabling normative pressure for FOSS in Ethiopia comes from EFOSSNet-the FOSS association. However, the pressure was rather weak to contribute for the deinstitutionalization of the institutional environment, which is favoring proprietary software.

Moreover, contributing to the constraining normative institutions for FOSS is the professional distinctions health professionals upheld. For example, informants in Ethiopia pointed out the health sector were expected to

focus on health aspects to legitimize their argument that software development was the primary responsibility of software firms and not the health department. These software firms, driven primarily by the principle of profit making, tended to pursue development through MS products, which undeniably had higher commercial value to the firm than FOSS. In addition, health sector managers did not believe that it was important to obtain the source code as it was the job of software companies and not themselves to customize the application in the future. Focusing only on health was the normative mechanism by which the organizational role of the health sector was seen confined. We argue that while such kind of professional role distinctions are important, understanding the significance of technology in health, there is a need that the health care sector should also go beyond the health matters and be actively involved in the choices of technological solutions. In conclusion, the different normative institutions were found to be enabling for both FOSS and proprietary products in Kerala, while in Ethiopia they were enabling only the use of proprietary systems.

5.3. The Cultural-cognitive Institutions (want to)

The study found out conflicting personal beliefs regarding the theoretical values of FOSS in both Kerala and Ethiopia. In one hand, stakeholders who are involved in FOSS paradigm view FOSS to positively contribute to the good of the health or other public sectors. The mentioned advantages of FOSS by this group of stakeholders were cost, availability of source code and interoperability. On the other hand, the other group of stakeholders perceived FOSS to come with disadvantages of hidden costs, poor support, and lack of expertise in working with already developed code. The theory of potential advantages of FOSS, arguably had been realized in practice in Kerala, thus helping to reinforce and diffuse the positive perceptions. The absence of the same in Ethiopia meant that contradicting arguments of the advantages of proprietary software over FOSS could not be resolved. Further, in Ethiopia, the normative and regulative elements of institutions were dominants and contributed to the reinforcement and diffusion of mindsets that want to follow propriety software paradigm.

In Kerala, there was also a degree of ambiguity in this regard that while the policy makers favored FOSS, other respondents showed preference towards Microsoft products. However, this could also be seen as an advantage, where the option of using either FOSS or proprietary systems remains open, and one option was not closed at the expense of the other. In Ethiopia, we found a belief system by policy makers that leap forging the digital divide was possible only by relying on well-established proprietary companies like Microsoft, and maybe is best left to multi-national corporations. This was related to fear that there is less accountability to FOSS than proprietary software. However, research shows that FOSS projects/firms follow varied governance mechanisms [40] that make them equally accountable as firms with propriety software development model. The influence of this institutional aspect towards micro level adoption of FOSS appeared to be similar in both settings.

While those who are proponents of FOSS perceive FOSS to have more advantages over proprietary software, the opponents counter argued.

5.4. Technology as the fourth Institutional Pillar (ought to have)

In addition to the three institutional pillars [10], we argue that technology by itself can play a role for its own adoption through the notions of network effects and increasing returns (Hanseth, 2000) that are drawn upon an economic perspective of technology adoptions.

We recognize the DHIS2 under the FOSS model has now reached the stage of becoming a global de facto standard for health management information systems in developing countries. More than 30 countries have adopted the software within the 15 years development and implementation time. The value of the software has increased through network effects, which in turn has increased the functionality and importance of the software making it attractive to more users and challenging the constraining institutional elements for its adoption. From being a tool for an aggregated health data, it has now expanded to being a tool for patient-based data. The continuous testing of the software by the involved countries has also contributed to prompt fixing of bugs. The more the software is adopted, the more it becomes improved increasing the return value of the software to new adopters [41] (Arthur, 1989). This aspect shows the importance of micro level adoption of FOSS to simulate and pressure change in the wider institutional setting, which has been constraining to FOSS. This is especially relevant to late adopters like the current case of Ethiopia and its interest in piloting DHIS2. However, early adopters like Kerala do not see this kind of enabling pressure. In Kerala, the afro-mentioned three institutional elements were more relevant than the technological pressure. To be consistent and complementing the typology of institutions (as discussed in section 2), we view the indicator for technological institutions with respect to adoption to be the presence of large installed base (number of user adopted the software). The basis for positive response towards such technological pressure would be the increasing return. While the technological pressure is enabling in Ethiopia as late adopter, it was constraining for Kerala as early adopter.

The following table presents a simplified version of how the complex institutional environment enables and constrains the adoption of FOSS in the Kerala and Ethiopia.

Table 3. Institutional Influences on FOSS adoption in public sectors

Institutional pillars	Kerala		Ethiopia	
	Constraining	Enabling	Constraining	Enabling
Regulative	NO	YES	YES	NO
Normative	NO	YES	YES	NO
Cultural-cognitive	YES	YES	YES	YES
Technology	YES	NO	NO	YES
FOSS adoption	YES		YES	

The table shows the combination of enabling normative and regulative institutions facilitates the adoption of FOSS in public sector organizations. The table suggests also, in the absence of regulative and normative institutions, the technology facilitates FOSS adoption once it has gained

large installed base. However, in the latter case, the FOSS nature becomes irrelevant and the adoption process takes relatively longer time. Therefore, we argue that the viable approach for FOSS adoption in public sector is strengthening the regulative and normative institutions in favor of FOSS.

6. Practical Implications: the “middle way”

The Kerala case highlights a stage of how certain de-institutionalizing forces regulative and normative has helped to erode the legitimacy of the previously established institutions of proprietary systems and slowly cultivate and include one based on FOSS.

Politically, in Kerala the historically existing communist governments have explicitly rejected proprietary systems. Consequently, in 2005, the new government formulated a policy explicitly guiding government departments to adopt FOSS. These policies have faced a strong inertia at user level to practically realize the policy vision for two basic reasons. This is because there are no sanctions against the use of proprietary system, and human actors feel uncertain to make a change from a system they have been used to for many years. So, despite the policy, we saw most of the health facilities using MS products. The only FOSS based application in the health sector was the DHIS2 software, which is running on MS-Windows, despite also having the option of being run on Linux.

Scholars such as [13] emphasizes the need to incrementally bridge the gap between the formal institutions (the ICT policy) and the informal constraints (e.g. capacity and norms) on the ground. As the education system produces more FOSS aware students, and the private sector provides more opportunities for them to work in FOSS, cultivation [42] towards integrated IT platform can be seen to be ongoing in Kerala. This then contributes to the gradual changeover of systems in the public health sector as well. Moreover, the government has established the intermediary organizations (TPSs) to facilitate public sector user departments to changeover to FOSS solutions, a process, which will further accelerate the changeover. In this context, the state government can be seen to be acting as an institutional entrepreneur and placing their power and resources to facilitate this process of change cultivation.

However, in this paper we are not trying to promote the sole use of FOSS in the public sector, as history with respect to existing proprietary systems is part of our reality, and needs to be addressed, and more proactively taken advantage. In both countries, stakeholders acknowledge the advantages and disadvantages of both systems, and thus we believe a proposal that facilitates the integration of FOSS with the already existing proprietary based systems and work practices would be more appropriate than positioning one over the other. In Ethiopia, the current scenario is not visible to enable this integration, and requires working with normative institutions such as introducing explicit FOSS education in the current education system. We have noticed an initial technological pressure, which might result in change in the margins of the complex institutional environment. However, an important step towards widespread incremental change

towards integrating FOSS with proprietary software could come by cultivating the normative institutions which are vital in creating awareness, moral obligations and changing the negative perceptions towards FOSS.

As the Kerala example shows, intermediary organizations like the TPS need to play a more active role in facilitating change processes and it can be taken as a lesson for the Ethiopian health care sector. More importantly, the current practices of public sector organizations such as tendering need to be expanded in scope so that both FOSS and proprietary systems can bid for, be evaluated, and may the “best system win”. The Ethiopian tender example where one option was shut out, we believe limits the opportunities of the public sector organization to take advantage of current technological developments.

The integration approach we propose thus involves more than a technical solution, but related to practices both at the level of decision making and also at the level of use. The DHIS2 use in Kerala provides a nice example of this, since while the application is based on FOSS technologies and is platform independent, at the clinics it is run on Windows keeping sensitively in mind the users preferences and capacities. However, the platform independence of the application provides the users with the option of a change over to another platform whenever and whatever the user chooses. The following figure depicts the “middle way” we are proposing.

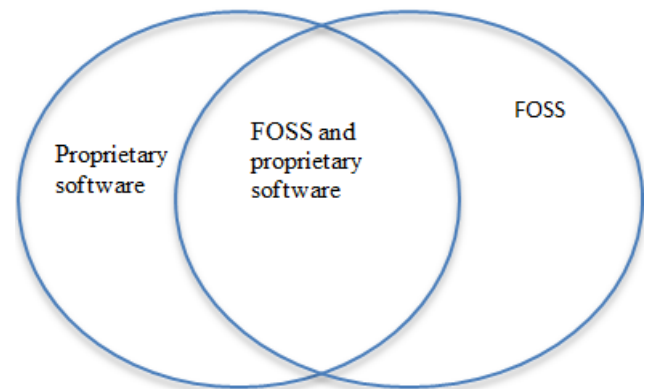


Figure 1. The “middle way” for both FOSS and proprietary software

7. Conclusions

While there is a significant amount of rhetoric about the potential of FOSS applications to overcome the digital divide and to enhance the quality of services delivery, there are challenges to put this rhetoric into practical benefits that can accrue good results. There is lack of sound evidence that bring the macro-micro dynamics together so as to support the understanding of the real challenges in the wider institutional environment and their implication to FOSS adoption. The institutional perspective taken in this paper emphasizes the need to unpack and understand the macro-level regulative, normative and cultural- institutions in various settings to cultivate change process to create an environment that takes into account both FOSS and proprietary systems as preferred IT solutions for the public sector. In relation to this, the macro level institutions: policy, education system, stakeholders’ perceptions, and role of mediating agencies have all been identified as being important actors in

enabling (and also constraining) these processes of change. Furthermore, at the micro-level the introduction of FOSS to an organization can stimulate change towards deinstitutionalizing the various institutional aspects that favors proprietary software. However, cultivating change towards a “middle way” technological platform, we argue, would be more sustainable if FOSS is properly introduced in the education system. A radical change can be achieved in the regulative institutions. Public sectors use of FOSS solution by itself can stimulate change in the education and regulative institutions.

Even though, we make such analytical distinctions of institutions for clarity, in reality, these are all intermingled and that they should be recognized as influencing each other.

By taking both macro- and micro level institutional analysis of the case studies, we contributed to the expansion of the analytical framework of institutions. The research set out with the assumption that FOSS adoption is more influenced by the surrounding institutions and that “network effects” may not have influence in FOSS adoption in public sectors if not combined with other institutional mechanisms. Network effects means “a product may simply be more valuable to each buyer; the more others have the product or service” [[43] p.7]. As a result, we took a sociological institutional perspective to study those influences. By doing so, we tried to understand how stakeholders in organizations create meaning drawn upon institutional aspects to legitimize their rejection or acceptance of FOSS. However, following upon the case through time shows that technology by itself creates also pressure for its adoption once it gets large installed base, consequently creating enabling environment for its adoption. Therefore, we recommend, future IS studies that seeks to apply this analytical framework to take into account the fourth institutional pillar to have a more comprehensive analytical tool in their study.

Concluding on a more positive note, we would like to emphasize that FOSS needs to be actively taken into the agenda of public sector digitization efforts in developing countries. However, this agenda should not be built upon utopian idealism but on the practical needs. FOSS like proprietary systems is never “fully” free as there are always costs involved in their customization, capacity building and maintenance. However, by eliminating the license costs, it is significantly “more free” than proprietary systems and it fosters innovation as the source code is accessible. Thus, there is a need to carefully evaluate the pros and cons of the different options, and make informed choices keeping the broader aims in mind of building sustainable, scalable systems that can effectively contribute to improve service delivery in the public sector.

Acknowledgement

We acknowledge all respondents in Ethiopia and India.

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