Global Standards and Local Health Information Systems
Applications:
Understanding their interplay
in the context of Tajikistan

by

Latifov Murodillo Abdusamadovich

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University of Oslo, Norway

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Dedicated to

my father,

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ABBREVIATIONS AND ACRONYMS

ADB: Asian Development Bank, 22, 23
CRO: Civil Registry Office, 20, 21, 25, 47, 58, 59, 74, 78, 79, 94
CRS: Civil Registry System, 58, 59, 60
DHIS2: District Health Information System version 2, 2, 15, 18, 24, 25, 61, 62, 70, 73, 79, 80, 90
DICOM: Digital Imaging and Communications in Medicine, standard for handling, storing, printing, and transmitting information in medical imaging, 14
DRD: Direct ruled districts, 58
DUNS: Data Universal Numbering System, 15
EC: European Commission, 23
EDI: Electronic data interchange, 33, 38
EHRcom: Electronic Health Record Communication, European data exchange standard, 14
EPR: Electronic Patient Record, 61
FGP: Family group practice, 23
GBP: Guaranteed Benefit Package, 57, 58, 61
GDP: Gross domestic product, 51
HII: Health Information Infrastructure, 3, 20, 21, 26, 35, 36, 37, 88, 89
HIS: Health information system, 6, 10, 12, 13, 14, 16, 18, 19, 20, 24, 25, 27, 34, 35, 38, 57, 58, 60, 64, 86, 87, 88, 89, 92, 93, 94
HISP: Health Information Systems Programme, 10, 18, 22, 23, 24, 35, 63, 69, 70, 75, 79, 86, 89
HIV/AIDS: Human immunodeficiency virus infection / acquired immunodeficiency syndrome, 55, 64
HL7: Health level 7, data exchange standard, 14
HMIS: Health Management Information System, 5, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 28, 29, 31, 32, 35, 37, 39, 42, 44, 47, 52, 56, 58, 59, 60, 61, 62, 63, 64, 72, 73, 74, 75, 76, 77, 78, 80, 82, 83, 84, 87, 88, 89, 90, 91, 92, 93, 94, 95
HMN: Health Metrics Network, 58, 59, 60, 75
HospMIS: Hospital Management Information System, 22, 24, 47, 63, 64
HSRP: Health System Reform Programme, 22, 23, 61
IAD: Institutional Analysis and Development framework, 43
ICD: International Classification of Diseases, 11, 14, 19, 25, 34, 55, 70, 85, 89, 90, 91, 94
ICT: Information and communication technologies, 10, 12, 44, 64, 82, 85
II: Information Infrastructure, 23, 27, 28, 29, 33, 35, 36, 38, 43, 44, 45, 59, 85, 94
ILO: International Labour Organization, 50
IS: Information systems, 10, 12, 27, 37, 40, 80
ISO: International Organization for Standardization, 30, 33
MDG: Millennium Development Goals, 25
MoH: Ministry of Health, 2, 5, 15, 21, 25, 47, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 70, 76, 79, 88
NGO: Non-governmental organization, 15
NHS: National Health System, 25, 38, 57
NRHM: National Rural Health Mission, 62, 63
PhD: Doctor of Philosophy, 15, 16, 74
PHD: Provincial health department, 52
RCSMI: Republican Centre for Statistics and Medical Information, 2, 20, 60, 70
TB: Tuberculosis, 56, 64
UiO: University of Oslo, 2, 15
UNDP: United Nations Development Programme, 49
US: United States of America, 14, 49, 51
USAID: United States Agency for International Development, 56
WB: World Bank, 49
WHO: World Health Organization, 25, 51, 56, 58, 85
ABSTRACT

This thesis presents the study of the dynamics of global/local interplay of standards related to the development and implementation of Health Information Systems (HIS) with a primary focus on Tajikistan. These standards come in form of software artifacts, classifications and guidelines, practices, procedures and many others. Implementing such global standards is challenged by the existing particularities in the context of implementation, but where also exist various similarities with global systems. The differences as well as similarities play out during implementation processes, spanning different institutional and technical dimensions embedded both in the global standards and also the national HIS. This raises the paradox of standards being both a uniform solution, whilst also containing elements of locality. Managing this paradox remains a clear challenge in HIS implementation initiatives.

This thesis thus tries to extend our understanding of the dynamics of standardization in the course of HIS implementation in a developing country context. Particularly it tries to address issues related to localization of global standards as part of a process of information infrastructure building which involves negotiation, cultivation, work-arounds and contextualization. The thesis takes a socio-technical perspective to understanding the interplay and draws upon theoretical concepts from the domains of information infrastructure, standards and standardization, and institutional theory. Together, the concepts provide an with an analytical lens to study the tripartite relation between the actors (human and non-human) involved, the standard, and the topic the standard seeks to address.

Empirically, this research has been carried out over the last 4 years, and a primary focus has been on the health sector in Tajikistan. I have been engaged in this reform process since 2007 as an action researcher in various tasks such as software development, capacity development, mediating between the international development partners and the ministry, and various others. An underlying focus has been around negotiating different standards, such as indicators, trying to localize and adapt them in the software, and training. Another component of my empirical work took place in a district hospital in North India, where I was involved in the design, development and implementation of a patient record based hospital information system, which gave me insights to a different class of standards relevant to HIS.

The empirical work was aimed at addressing two key research questions: One is related to understanding the nature of dynamics in the interplay between global standards and their local adaptations and the other studies challenges and opportunities arising from global/local interplay of standardization process, and how these processes are best managed. While first question helps to understand factors and entities influencing process of localization of global standards and their interplay, the second question helps to develop strategies for guiding implementation of global standards into the national HIS.

A key theoretical contribution has been the development of a conceptual framework to help analyze the relationship between actors, standards and the topic of interest to actors. This further allows the development of a perspective to understand the process of incremental and
transparent introduction of technology as supporting existing institutional arrangements. Another practical contribution has been the formulation of a three dimensional framework of completeness, fittingness, and actionability for analysing the data element - indicator linkage. The notion of facets of infrastructure proposed in this thesis helps to develop guidelines for creating teams to do a larger task of HIS implementation. These implications, although developed through empirical experiences from Tajikistan and India, can potentially be applied to other contexts of countries and functional domains such as Civil Registration.
PREFACE

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This thesis consists of five papers as well as an introduction. The papers, as listed below, are included as appendixes:


Murodillo Abdusamadovich Latifov and Sundeep Sahay (2013). Challenges in Moving to "Health Information for Action": an Infrastructural Perspective from a Case Study in Tajikistan, Information Technology for Development, in print
Chapter 1

1. Introduction

This chapter introduces my research on processes of standardizing Health Management Information Systems (HMIS) in the context of developing countries more broadly, and Tajikistan in particular. The chapter is organized into seven sections. In section one, I outline the research problem and position my research within the larger body of research in information systems (IS) standardization. Section two outlines my personal motivation, after which I pose the main research questions addressed in this thesis. Sections three and four are dedicated to introducing the empirical approach and conceptual perspectives respectively. In section five, I provide a brief overview of the research settings. Finally, in section six, I present the theoretical and practical contributions of the research and outline the organization of this thesis in section seven.

1.1. Problem Setting and Positioning of the Research

Healthcare organizations in both developing and developed countries use information and communication technologies (ICTs) to try to lower costs, reduce paper, increase integration and better use information to strengthen health management. But introducing ICT supported health information systems (HIS) is not necessarily the “silver bullet” that solves the efficiency problems of the health services (Sandiford, Annett & Cibulskis, 1992; Avgerou, 2000; Raghvendra and Sahay, 2006). Many of the challenges are institutions and context dependent, such as inadequate numbers of appropriately trained staff, weak hardware and software maintenance mechanisms, and various cultural-political factors (Sauerborn and Lippeveld, 2000). Addressing these and other constraints have been key elements in efforts towards strengthening of HIS as a part of health system reform agendas in various developing countries. Despite the huge investments being made both in time and money, the results have been far lower than the potential for change that is promised (Braa, Monteiro & Sahay, 2004; Avgerou and Walsham, 2000; Heeks and Baark, 1999; Sanford, Kanga & Ahmed, 1994).

Although having many similarities across countries, HIS\(^1\) tend to be idiosyncratic to the country where they are developed and used – universal and uniform models tend to be

\(^1\) In this thesis HIS refers to computerized health information systems
limited: “There is no universal formula for a precise combination of data sources that will be optimal in every setting. Much depends on existing systems that are themselves products of history and social development” (AbouZahr and Boerma, 2005:579). “They differ from country to country depending upon historical accident and the interest of policy makers, administrators and researchers” (Foltz, 1993:347). One of the reasons for this, as Foltz argues, is the varying development levels across countries. There are also other variations with respect to infrastructure, human resources capacity, geography, governance systems and donor influences that prevent the application of uniform solutions. For example, in India a large part of inpatient care is provided by private hospitals, whereas in Tajikistan public hospitals are the main providers. While research has emphatically established that HIS implementation needs to be sensitive to local contexts (Avgerou, 2002; Walsham 2001; Avgerou and Walsham, 2000; Walsham, Symons and Waema, 1988), it also tends to be the case that these global/local collisions are over-emphasized, and that generification and localization of standards and applications are possible (Pollock, Williams & D’Adderio, 2007; Rolland and Monteiro, 2002). There are “some common elements” which could be “adapted” to different contexts (Foltz, 1993). For example, while routine health information flows across various levels from the community to the national ministry, the number of levels may vary across countries depending on policies, size of catchment population, disease profiles and availability of doctors. While there are some universal health programmes on which data is reported (such as Maternal and Child Health or Integrated Disease Surveillance Programme), there are others (based on environment and major infectious diseases, e.g. Tuberculosis programme in Tajikistan) which are specific to a country and the disease burden that they are grappling with, or the priorities that the donors have. The medium of data collection and level of data aggregation will also vary across countries based on national priorities, infrastructure availability, and human resource capacity. These variations, for example within countries where some districts can report data while others cannot because of infrastructural constraints, can be problematic for national managers who need data from all districts for their planning purposes. Given that we are often confronted during implementation (of global solutions) with both similarities and differences, the challenge becomes of how to reconcile the two, and build strategies for creating and managing “hybrids” (AHIMA, 2010; Kumar, Subramanian and Yauger, 1997) or of obtaining a “pragmatic balance” (Rolland and Monteiro, 2002) between global standards and local particularities.
These similarities and differences play out across different institutional and technical dimensions of the HIS implementation. A key techno-institutional element is that of “standards”, which refers to a uniform solution, but which paradoxically also contains elements of locality and independence (Bowker and Star, 1999). In the health sector, standards are a key component of HIS, including data sets, data formats, periodicity, data exchange protocols, software, and various routines and practices around data collection and processing. Standards are not just technical artefacts, but include both technical and social dimensions, which seek to provide uniformity while also being sensitive to locality and context. In this way, standards are an integral component of the larger information system, their content and process of implementation, involving organisational rules, routines and procedures (formal and informal) as well as technological components.

The nature of standards vary across the kinds of applications, whether it is for use in statistics based reporting of a HMIS or a patient based hospital management system. Sauerborn and Lippeveld (2000) conceptually describe a HMIS as: “Health information systems integrate data collection, processing, reporting and use of information necessary for improving health service effectiveness and efficiency through better management at all levels of health services” (Sauerborn and Lippeveld, 2000:3). In such a HMIS, the standards in question would be related to the data sets composed of data elements and indicators generated from them, formats of reporting and their periodicities. In a patient based system, there are additionally different standards such as those for data interchange (e.g. HL7, EHRcom, DICOM) and disease diagnosis (ICD-10). Given my perspective on standards as techno-institutional artefacts, it is important to note what are the kinds of standards we are talking about; for what technologies are they developed for and the systems and practices that they support. While my primary focus is on standards for aggregate or statistical data, I have also studied patient based systems used within hospitals. This has helped to deepen my understanding of standards from various perspectives, and of different systems in the context of healthcare.

1.2. Personal Motivation and Research Questions

My interest in software implementation, especially with respect to the issue of standards and standardization, arose from the early days of my involvement with IT projects of various scales and contexts, in different roles, from a software developer, to a team coordinator and project manager. Working for a US based company in Tajikistan specializing in data
warehousing applications, which provided analytical services for Fortune 500 companies, I realized the need and importance of standardization in the development of large scale systems. One of the company’s clients specializing in real estate business had branch offices in many countries in all continents. Operational data from these offices was periodically collected for data warehousing purposes in a variety of formats and involving different types of content. Some offices reported in Excel sheets, others used comma separated values and some even sent a copy of the operational database. The data cleaning process was most challenging and costly involving the Dun and Bradstreet cleansing service and required the assigning of a DUNS (Data Universal Numbering System) number. I was surprised to study how Dun and Bradstreet maintained the global database of enterprises, while the Real Estate Company could not implement a standard approach around their information systems in its branch offices.

I joined the Global Infrastructures group of the University of Oslo (UiO) as a PhD student in the autumn of 2008. In 2007, I received an invitation from a friend to meet with a group of researchers from UiO, who were working on a project related to HMIS design and implementation in Tajikistan and required some technical assistance from local staff. The next day, I came to the MoH office, where a Professor and three PhD students were engaged in a discussion with a local NGO, donor representatives and some MoH staff. The medium of conversation was between English and Russian (or Tajik), and I got pulled into the role of mediating in both – the global and local. In this meeting, the participants discussed strategies and approaches for customizing and piloting of the DHIS2 (District Health Information System version 2) as the national HMIS of Tajikistan. DHIS2 is an open source software application designed specifically for HMIS in developing country contexts. Further, DHIS2 is a modular application designed and built with high customizability considering varying needs and setups which are country specific. The efforts towards designing for universality in DHIS2 and its collision with the idiosyncrasies of Tajikistan healthcare provided an interesting arena to study various aspects of standardization including the global/local dilemma, and the challenges of implementation. As a person from the outside, relying on my past experience, I wondered if the ambitious plan of the MoH representatives could match with the proposal being made by the experts from UiO, or could it be implemented at all? Later after the meeting, I was given an assignment to support the customization of the MoH reporting forms in the electronic version, and the Professor also briefly explained me the
philosophy behind this intervention, while observing my interest to become a part of this initiative.

Working for a couple of months with this project, I realized the need for conceptualization of the whole process of change with regards to HMIS along with other ongoing health sector reforms of Tajikistan. The key idea was around standardization in terms of unifying data collection and reporting, bringing common tooling and techniques to play, while dealing with the vast amounts of data and formats. From a different perspective, the interaction of donor organization and the various national stakeholders took place through negotiations, often charged with strong political interests, where each side came up with its own arguments and visions, sometimes leading to consensus, but more often than not to conflicts and lack of agreements with adverse implications on the HMIS implementation. Donor organizations want to see appropriate use of allocated funds, sustainability, and compatibility with global efforts, while the local authorities are often concerned with issues, such as the loss of control of an existing system, and the implications of the new system failing or being sub-optimal. Such negotiations potentially could be useful in generating constructive solutions to challenging problems of standardization. Studying interactions between actors at different levels, and seeing outcomes of practical experiments from the field, helped me to develop an understanding that standards are not just a technological process or product, but are shaped by historical conditions; social and material values of organizations, and most importantly by people and their everyday practices.

During the course of my PhD journey, I have proceeded with my research focusing on the central role of standards in shaping processes of HMIS implementation. Being informed also by institutional theory, I have looked at issues beyond technology to also try and understand aspects of employee motivation, information needs and infrastructures. These issues have provided me with useful lenses to study and interpret the research challenge of standardization. Throughout the research period of four years, I have often formulated and reformulated my assumptions and hypotheses around the research problem, which have further shaped my empirical findings and theoretical framing of standards and standardization, and their interplay with national HIS implementation processes.

Implementing global standards could be seen as a process of generification (Pollock, Williams and D’Adderio, 2007) of local practices, where the characteristics of the local context gets progressively removed, while key core and common elements are maintained.
Local implementations take place together with ongoing processes of localization of these global standards (Pollock, Williams & D’Adderio, 2007; Braa et al., 2007). When standards are set and agreed upon at a supra-national level, they still may undergo sub-locale adaptation or cross-contextualization (Jarulaitis and Monteiro, 2011). Given the above scenarios, standardization processes could be termed as modes of “generification”, “localization” and “contextualization”. Large scale information systems are difficult to adapt to other contexts than that they are built for, because of being bound by ‘time’ and ‘space’ and idiosyncrasies of locales they are originally built for (Berg, 1997). This raises the need for efforts of local actors to make such a system work in the specific setting (McLaughlin et al., 1999).

Standardization of HMIS (of any mode) as a complex socio-technical process is composed of sub-processes involving various human and non-human components, each having varying levels of relations with regards to other components and the whole process. I believe the study of these relations will help to better understand standardization process and the nature of the global/local interplay of standards. With this background, the thesis seeks to address the following research questions:

1. What are the nature of dynamics in the interplay between global standards and local adaptations within the context of an in country HMIS implementation?

2. What are the challenges and opportunities which both arise during the course of the above interplay, and how can we leverage upon the opportunities while mitigating the adverse effects of these challenges?

The key questions posed are further made more concrete and operational in chapter 2, after discussion of the theoretical grounds of the research and presenting the proposed analytical framework. A key focus point relates to my assumption that negotiation efforts underlie the standardization process, which in turn is shaped by the actors involved and their level of interests or not in the standard. While negotiation processes tend to be open and evolving with unpredictable outcomes, their particularities shape standardization processes in context. The knowledge which the above analysis generates will focus around the understanding of the issues that come into play while trying to implement global elements of standards (such as related to software or disease classification codes), and the efforts involved in trying to make it work in local settings.
1.3. Empirical approach

Standards are primarily meant to reduce complexities and lower costs of systems development, and standardization process aimed to reach these goals is generally approached through ongoing processes of negotiations. Direct participation and observations of these different negotiation processes around the various standards – software, data related, and classification systems – are important components of the empirical approach.

Empirically, the research questions have been studied from both the global and local perspectives through an action research approach guided within an interpretive tradition. Global and local represent two relative perspectives, where the global implies working on issues that have implications for a multiplicity of contexts, countries, simultaneously, and the local implies working in the context of a country, in my case Tajikistan and India.

My research is situated within the framework of the global Health Information Systems Programme (HISP), being coordinated by the University of Oslo, Norway, since the mid-nineties and active now in more than 25 countries. There are various activities in HISP that are global, such as the development of open source software capable of being adapted to different countries. Then there are activities specific to make the HIS work in particular countries, including software customization, training, implementation and dealing with the local politics. During 2009, I actively participated in global events, specifically global software development activities, being a member of global team of developers, located in Oslo. This group is responsible for the development of generic modules of the DHIS2 for multiple countries as a global product, and I was simultaneously involved in the process of customizing DHIS2 for Tajikistan. Working with the global team, I gained knowledge of the different requirements also of other countries where DHIS2 was being used, and how the needs for Tajikistan compared with these. At the local level in Tajikistan, I engaged in various activities from working with donors, software customization, design, implementation, training, and managing infrastructure. All these activities have involved me in different processes of negotiations with different sets of actors.

These different activities have taken place across various phases (starting 2008 up to the writing of this thesis) of the HMIS development and implementation process in Tajikistan. Also, during this period, I had four visits (each lasting more than a month) for participating in practical system design and development activities of a patient record based hospital information system in a district hospital in a state in north India. From the vantage point of
having empirical evidence across countries and also different systems, I could participate in both the global and local level activities, including standards of software and classification systems; both in their development and implementation. I could both come to understand the implications from the Indian experience for Tajikistan, and also understand how differently both countries were trying to adopt standards like the International Classification of Diseases (ICD) to their respective local contexts. The historical contexts matters, as I learnt during my empirical work and also readings, with significant implications on what standards are adopted and how they are localized.

Tajikistan broke away in the nineties from the Soviet Union as a “spontaneous transition” (Braguinsky and Yavlinski, 2000), whereas India has had a more stable socio-political landscape over the same period. The Tajikistan system lacks the established institutional arrangements of Western economies and democracy, creating major challenges in implementing HMIS, as there existed a weak common understanding amongst the actors involved of broader issues such as of how national norms relate to existing systems (such as definitions of health indicators). This then creates dependencies on external donors for expertise and money, infusing a set of global dynamics and tensions. In India, where institutions are more deep rooted, the flexibility to change or introducing new standards are less problematic as gain or loss from doing so are arguably more evident or better understood by the stakeholders. These processes are also more internally driven in India than being influenced by external donors as is the case in Tajikistan.

1.4. Conceptual perspective

My approach to studying HIS, standards, and the global-local interplay is informed by a theoretical perspective grounded in information infrastructure theory (Star and Ruhleder, 1996; Ciborra 2000; Hanseth and Ciborra, 2007), which seeks to study the mutual relations between technology, people, institutions, and the processes through which this ensemble evolves over time. This perspective pays special attention to the role of standards, their flexibility or not in change and in being changed, which are known to be influenced by existing institutional arrangements, and at the same time influencing the very processes which maintain it in an organization (Hanseth et al., 1996). This then requires implementation to be conceived as a strategic task, involving issues beyond the technology and including aspects of the organisational context, governance and resource management, where multiple actors such as field level health providers, district managers, administrators, and global
players are involved. This broad scope then encourages an adoption of an approach of a “Health Information Infrastructure” (HII), which explicitly examines the socio-technical networks around the system, rather than keeping the focus limited to the standalone HMIS. I strengthen the information infrastructure perspective with concepts drawn from Institutional theory, related to for example incentives, to help develop a broader understanding of standards, how these are introduced and maintained in organizational settings, and the opportunities and challenges that so arise.

Information infrastructures are conceived as spanning across geographic and organizational boundaries, providing the unique opportunity to study a phenomenon, such as the implementation of standards, from both the macro and micro perspectives at the same time. As such, in this thesis, the focus is on the HII and the underlying standards which are in the process of being designed and set up in the context of Tajikistan and India, and it becomes the unit of analysis in my research. Being connected to this HII, different organizations may have varying roles in the standardization process, including in their design and implementation. For example in Tajikistan, the HII spreads beyond single organizations, and involves multiple stakeholders, including agencies such as the Republican Centre for Statistics and Medical Information (RCSMI), the State Statistics Agency (SSA) and the Civil Registry Office (CRO). These different organizations have their own respective infrastructures, and systems of provision and demand. Together, these and other agencies can be seen as shaping an “organization field” (DiMaggio and Powell, 1983) representing a sphere of influence into the design, development, use and evolution of the HII and the underlying standards. This sphere of influence is defined by the different institutional logics – representing “both supra-organizational patterns of activity by which individuals and organizations produce and reproduce their material subsistence and organize time and space. They are also symbolic systems, ways of ordering reality, thereby rendering experience of time and space meaningful” (Friedland and Alford, 1991:243). The concept of institutional logics helps me to better understand the underlying patterns of activity in an organization, for example, the logic of statistics which underpin the design and use of HIS.

Another concept that is relevant for my analysis drawn from institutional theory is that of “incentives”. The concept of incentives is mainly used to denote purposeful action of individuals both alone and as member of social groups, the choice of which is guided by the expectation of some sort of rewards (Armstrong, 2002). Incentives can be positive or
negative depending on an individual’s perception of changes resulting from particular actions taken from within a set of rules in a particular physical and social context (Ostrom, Schroeder & Wynne, 1993; Campbell, 1995). The concept of incentives is used to understand behaviour in the accepting or not of standards, and their roles in shaping processes of negotiations.

One key objective of implementing standards is strong and robust HMIS, effectiveness of which is determined through measuring incentives organizations and individuals receive as a result of the actions they perform. These incentives can come in various forms such as reduced paperwork, strengthening accessibility to analytical data or others, or even in monetary terms (such as “Performance based Pay”). In my case, the Central MoH and CRO are seen (as supra-national bodies) to have more regulative influence, setting the overall agenda around what standards are to be used and how, while other sub-regional and district organizations are expected to only comply. The HII, in which the standards are an integral part, acts as the medium of interactions and carrier of institutions, including incentives, as a means to encourage the compliance to standards. When a new standard is commonly accepted and put into action, it is said to be legitimate. For example, in healthcare, “pay for performance” is a mechanism used by healthcare providers for improving quality of care through providing incentives to medical practitioners in the form of rewards for better performance (Garber, 2005).

The infrastructure and institutional perspectives also help to understand that the design and introduction of standards is not a standalone task, a process by its own, but is intertwined with other Ministry of Health processes such as decentralization, health financing, and administrative restructuring, which are in turn aligned with other aspects related to the national strategy for development. For instance, decentralization may seek to achieve high level of healthcare service delivery by empowering district level managers to take decisions for local action. These processes are fundamentally aligned with the HMIS strengthening tasks, such that the local manager can access relevant information to make appropriate decisions and also should have sufficient funds and resources to do so. Here it becomes important that while decentralization may result in the “blooming of thousand flowers” where each district health facility independently creates their own data sets and formats, if the entire process is not well coordinated, it may disrupt the national standardization process. Coordination of such efforts requires high level of expertise and competence, which in the case of developing countries like Tajikistan, normally comes through donor supported
technical assistance. This then tends to introduce further global solutions which will need to be negotiated for local use. Bringing these global solutions to local socio-technical realities then requires various standards to streamline implementation and future development of underlying solutions. Thus the entire HMIS implementation process is tightly coupled with other parallel processes, while having its own sub-locality, with various similarities and differences. An information infrastructure perspective helps to explicitly focus on understanding these inter-linkages.

After having introduced the research questions and the conceptual perspective to help approach these questions, in the next section, I present the research settings for my empirical work.

### 1.5. Research settings

The research reported in this thesis is based primarily on the study of ongoing reforms of the health sector of Tajikistan, particularly related to HMIS redesign, development and implementation. Also I was fortunate to take part in design, development and implementation of hospital management information system (HospMIS) in India. The development of the HMIS in Tajikistan started as part of larger project for health care reform called Health System Reform Programme (HSRP) with a loan from Asian Development Bank (ADB). The HSRP started in 2004 with goals to improve overall health conditions and in particular for woman, children and poor, with objectives to strengthen health system efficiency and health management capacity, with a key focus on the HMIS. In India, HospMIS was initiated and funded by the Ministry of Health and welfare of Himachal Pradesh State and HISP India as implementing partner, aiming at improved service delivery, reduced costs and better management of pharmacy at public hospitals.

In its design, the HSRP had three distinct components: institutional development of the health sector; drug supply and quality control; and efficient and sustainable delivery of a pro-poor health service package. These objectives and plan of actions were designed based on a comprehensive social sector study by ADB, which identified “major concerns in the health sector: (i) shrunken public health expenditures and inefficient use of resources, (ii) collapsed public health care system, (iii) increased out-of-pocket payment by beneficiaries, (iv) reduced access to and utilization of health services, in particular by the poor, (v) weakened and unreliable HMIS, (vi) high burden of diseases and precarious health status of the population, and, (vii) limited managerial, technical, administrative, and financial capacity at all levels of
the health sector” (ADB report, 2003). One of the key recommendations of this report was to strengthen HMIS, stating:

“An effective health management information system (HMIS) is essential for planning, reforming, managing, and monitoring the health sector of Tajikistan. However, reliable and disaggregated information is currently lacking. The lack of reliable data on the existing workforce seriously hampers effective human resource development planning. Financing data is required to design financing strategies and develop mechanisms for performance-based budget allocations. HMIS needs streamlining. The Health Sector Reform Project (HSRP) aims to reform the health care delivery system by introducing the family group practice (FGP) and the capitation payment scheme. It is important to ensure that HMIS functions effectively in monitoring the new systems’ performance and evaluating the impacts of changes.”

(ADB report, 2003:45)

In the fall of 2007, under the first component – institutional development of the health sector, the piloting of a redesigned HMIS started in 5 rural districts, which were selected for their severity of poverty and the high levels of infant and maternal mortality. Most of these districts are located in mountainous areas with limited transport and communication infrastructure, which made piloting extremely difficult. Despite these shortcomings, the pilot project was termed a “success”, encouraging in 2008 the European Commission (EC) to take over the processes related to the future support of HMIS development and implementation. This project was based on grants and planned to be implemented in three phases solely dedicated to HMIS. Phase I (2009) was a comprehensive study of the existing HMIS, including vertical programmes and demography. Phase II (2010-2011) was preparatory and focused on planning the national strategy and roll out plan for HMIS implementation. The HMIS implementation strategy provided a detailed description of interventions required to reach a fully functional system by 2015. Phase III, which started early 2013, will be the actual implementation of HMIS. My empirical work covers both the ADB and EC project periods, where I have worked together with national and international experts providing technical assistance in terms of guidelines, trainings and also developing software solutions. Global HISP was engaged in one such intervention during 2007 – 2008, and has continued over the years in different degrees and responsibilities. As a member of Global HISP and a Tajikistan national working in my home country, I have been privileged in being able to
observe and engage with global and local developments, and also examine their dynamic interplay – a key focus of my thesis.

To briefly introduce HISP. HISP was initially started through the Department of Informatics, University of Oslo in 1994 as a small project in South Africa and gradually implemented nationwide. Since around 2000, HISP has rapidly expanded from South Africa to multiple African (such as Kenya, Ghana, Uganda, Tanzania, etc.) and also Asian countries such as India, Bangladesh, Sri Lanka, Vietnam and Tajikistan. The HISP experience is marked by an accumulation of various local successes (and also “failures”), which contributes to the global repository of HMIS knowledge, practices and material artefacts like the DHIS2 software, which today has evolved into a global standard, and is in the process of being implemented in Tajikistan, a process in which I have been integrally involved. My involvement in HospMIS implementation was organized through HISP India. My main activities were design and development of various modules for the system that are generic and easily adjustable to various locales. Through this exercise I learned dynamics global/local interplay of standards in design and development of HospMIS as system was intended to be scaled to other 20 hospitals in the state.

Action research, labelled as networks of action (Braa et al., 2005), is the underlying principle of the HISP approach, which has contributed to the development and evolution of DHIS2, and also in supporting implementation processes in various countries (Braa and Sahay, 2012). DHIS2 is a modular web based application, established as a de-facto standard for HMIS in many countries, it is flexible and able to be adjusted to different local requirements (more information could be found at dhis2.org and hispindia.org). The socio-technical efforts around the process of designing and implementing DHIS2 in the realities of Tajikistan were the focus of my practical involvement. I was particularly interested in understanding the interplay between global standards and systems and how these were adapted into local national and sub-national contexts.

There are different forms and types of standards relevant in a HIS, and this thesis focuses on issues related to software, data, indicators, and processes around their design and use. Table 1.1 below describes the type of standards used in the context of Tajikistan HIS, their global and local implications and processes that link the two. This table, in short, summarizes the scope of my analysis around the broad area of standards.
Table 1.1 Scope of HIS related Standards Studied in this Research

<table>
<thead>
<tr>
<th>Type of Standard</th>
<th>What is Global</th>
<th>What is Local</th>
<th>Process of interplay between global-local</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHIS2</td>
<td>Data warehouse, best known practices</td>
<td>Localized user interface, customized or developed modules</td>
<td>Localization of user interface, customizing modules according to the local needs New and particular features/functionality development Contributing to global core</td>
</tr>
<tr>
<td>Indicators</td>
<td>International expertise, MDG, WHO indicators</td>
<td>Selection of indicators based on the National Health Strategy indicators, MDG</td>
<td>National set of indicators are aligned with NHS, negotiations between what to be selected and not Linking of indicators to be generated with data elements being collected – a gross mismatch</td>
</tr>
<tr>
<td>ICD-10</td>
<td>WHO</td>
<td>SSA, CRO and MoH collaboration</td>
<td>Use of ICD-10 for primary health records, reducing recording and reporting forms Use for recording cause of death and demographics. Standard for communicating information with other peer organizations</td>
</tr>
<tr>
<td>Data Elements</td>
<td>Meta-data standard</td>
<td>National priorities for improving healthcare</td>
<td>Revision of primary and reporting forms, reduction of data elements to the need of NHS indicators</td>
</tr>
</tbody>
</table>

1.6. Expected contributions

Motivated by the practical need to understand the sources and the nature of global/local dynamics in standardization processes in HMIS implementation, I have structured and focused the investigation through a combination of concepts drawn from the domains of information infrastructure and institutional theory. Through this analysis, I expect to make the following contributions:

- To deepen the understanding of scope, sources and dynamics of global/local processes of localization of global standards in HMIS implementation through the lens of institutional theory within an information infrastructure perspective.

- By developing the concepts of incentives and facets of infrastructure, formulate insights and recommendations on how to manage negotiation processes in standard making, in a manner in which the effectiveness of local systems can be enhanced.
• Develop practical strategies for guiding implementation processes of global standards in the context of national HII in Tajikistan.

1.7. Organization of the thesis

The remainder of this thesis is structured as follows. Chapter 2 provides a review of the relevant literature, and following this, the analytical framework is suggested. Chapter 3 provides an overview of the research context followed by research approach and methods and a detailed description of the fieldwork carried out. Chapter 4 provides a reflection on my process of data analysis. In chapter 5, I present my findings by summarizing each of the five papers that contribute to this thesis, and their synthesis. The papers themselves are placed as Annexes 1-5 of this thesis. Chapter 6 presents the theoretical and practical contributions developed in this thesis. The final chapter presents some concluding remarks, and future research directions.
Chapter 2

2. Literature Review and a Theoretical Perspective

My research focuses on understanding the process and dynamics of global and local adaptations and the interplay of standards from a socio-technical perspective around HIS in Tajikistan particularly, and in developing countries more generally. Given this focus, I draw upon three main bodies of research to inform my analysis. The first relates to the Information Infrastructure (II) perspective, enabling me to examine the challenge of standards from a socio-technical viewpoint, where a key concern is to see the infrastructure as something that evolves over time. The second domain concerns the literature on standards, the key object of my thesis, and which is particularly well handled by II theory. The third domain informing the analysis is related to institutional theory, especially to understand the role of history in shaping implementation processes, making it especially complex to change what already exists. Institutional theory has been criticized for under-emphasizing the role of materiality (technology), treating it largely as a black box and taken for granted. Arguably, II theory with its strong socio-technical focus helps to a certain degree to redress this balance. Institutional theory then emphasises the role of human agency as a key carrier of institutions (Orlikowski and Scott, 2008), which helps to understand where the stimulus for change is situated. The cross-fertilization of the II and institutional theory perspectives is beneficial to address issues of standards, their design and use in organizational contexts. While II and Institutional theories provide a holistic approach in doing research in standards and standardization, both highly emphasise and recognize social and technical compartments of IS research. In some parts of the analysis, I discuss social and technical aspects separately for analytical purposes. Being in the interpretive stance of IS research, this thesis follows Klein and Myers (1999) principles with key argument being hermeneutic circles, which implies that understanding of the complex whole is made up of a preconception of its parts and their interrelations.

In this chapter, I start by sketching out key concepts from the II perspective (section 1) and how these inform my analysis. Following from this, I focus on discussing the role of standards in IIIs (section 2), which describes the object of my study within the framework of the global-local interplay. I then discuss some key concepts drawn from Institutional Theory (section 3) which helps to develop insights on processes of change within organizations. Institutional Theory and standardization are then discussed (section 4) and finally (in section
5), I bring together the concepts discussed to present a more comprehensive theoretical framework.

2.1. Information Infrastructure Perspective

Many authors have argued, and now it is an established “fact” that information systems should be treated not merely as technical systems (Lee, 1999), but rather as socio-technical networks (Walsham, 1998), constituted as a “web” of technical artefacts, people, and procedures immersed in a particular context (Kling and Scacchi, 1982). Especially, in the process of information systems implementation, it is of high importance to emphasize equally organizational, infrastructural and technological issues. Thus understanding how IT artefacts align with existing formal and informal institutional arrangements and also the underlying infrastructures becomes crucial. Standardization as such as a process of alignment is not isolated, but part of a larger process of II building (Nielsen, 2006), where new solutions are built on top of already existing ones (termed as the installed base) and influenced by the ongoing institutional arrangements (Hanseth et al., 2001; Cibora et al., 2000). An II is defined as a shared, evolving, open, and heterogeneous installed base (Hanseth and Monteiro, 1998b; Cibora et al., 2000; Hanseth and Monteiro, 1997), being evolved for and by a large user community across diverse geographical and functional areas. It is thus qualitatively different from a standalone system which is composed of a limited number of independent entities.

The installed base represents already existing organizational arrangements, both technical and non-technical, including standards and technologies, organizational structures, social arrangements and institutionalized routines. Because the installed base is deeply rooted in the organizational settings and institutionalized practices, the whole II cannot be changed in one go and cannot be designed from scratch. Changes can only be built upon the existing installed base, which influences the way changes enter the II ecosystem (Hanseth and Monteiro, 1997). It has thus been argued that an II is never “designed from scratch”, and is instead ‘cultivated’ (Aanestad, 2002) as a process of incremental evolution.

Public healthcare is composed of administrative and health delivery systems, interlinked also through the use of HMIS, to help support both management decision making and also health care delivery. For the system to be effective, various institutional and technical dimensions need to be inter-linked across various levels of the health care administration. Bowker and Star (1998) have argued that information systems are necessarily both social and political, including the technical infrastructure (Bowker and Star, 1999). The HMIS needs to support
the full cycle of information management starting from data collection, report generation and the use of information for action. For each of these aspects of the cycle, different standards and procedures come into play, such as data entry forms for data capturing and the required indicators at the stage of information use. This involves a series of technical, social and political considerations that need to be taken up by the stakeholders through ongoing negotiation processes.

Use of networked and distributed technologies allows the HMIS to evolve by adding new nodes to the network, connected with affordable Internet or mobile connections and enforced using institutional rules and norms. The role of standards becomes increasingly important as systems become networked and complex (Fomin, Keil & Lyytinen, 2003) and the need for coordination increases. Similarly, Star and Ruhleder (1996) have argued that with the rise of decentralized technologies used across wide geographical distances for diverse applications, both the need for common standards and the need for situated, tailorable and flexible technologies grow stronger (Star and Ruhleder, 1996). Because IIIs are constantly changing in relation to an organization’s objectives and institutionalized work practices, these standards need to be flexible and easy to change (Hanseth, Monteiro and Hatling, 1996). However, making these changes is a non-trivial socio-technical challenge.

Timmermans and Epstein (2010) describe standards as socio-technical components aiming at rendering the world equivalent (universal) across cultures, time and geography. Universality and flexibility are two contradictory though important characteristics of standards, which needs to be balanced through changes in local practices and their global definitions. These changes and developments then necessarily take place around the installed base (Hanseth and Monteiro, 1997), and as it becomes increasingly deep rooted and impossible to change, they start to become irreversible (Hanseth and Monteiro, 1998).

In the next section, I discuss standards, their definitions and typologies, and how they are relevant to understanding IIIs.

2.2. Standards - building blocks of Information Infrastructures

Standards are fundamental for an II to effectively function (Hanseth, Monteiro and Hatling, 1996), allowing the various components of the infrastructure to work at different levels and elements, enabling integration through standardized interfaces, components, and protocols (Hanseth and Monteiro, 1997). A popular definition of standards given by the American
National Standards Policy Advisory Committee is: "A prescribed set of rules, conditions, or requirements concerning definitions of terms; classification of components; specification of materials, performance, or operations; delineation of procedures; or measurement of quantity and quality in describing materials, products, systems, services, or practices" (ANSPAC, 1978:6). While this definition is quite generic and covers various aspects of standards, ISO/IEC Guide 2, definition 3.2 defines standard as formal and approved “… document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context” (ISO/IEC Guide, 2004:12). Bowker and Star’s (1999) definition puts standard as “any set of agreed upon rules for the production of (textual or material) objects” (Bowker and Star, 1999:13).

Standards and standardization typically imply one another (Timmermans and Epstein, 2010:70). The subject of a standard establishes the standard and the standard shapes the subject. According to deVries (2003) standardization is “the activity of establishing and recording a limited set of solutions to actual or potential matching problems directed at benefits for the party or parties involved balancing their needs and intending and expecting that these solutions will be repeatedly or continuously used during a certain period by a substantial number of the parties for whom they are meant” (deVries, 2003:155).

While deVries’ view fits well with the above listed definitions of standards, there are still other specific situations that require standards to be treated differently. For example, Brunsson and Jacobsson (2000) describe situations where standards take the role of regulatory and coordination activities, when organizations are weak and are not able to manage the process by direct orders. Or standards are often promulgated by expert knowledge, representing a form of ‘embedded authority’ (ibid, 2000:42). Hanseth and Monteiro (1997) empirically drawing upon an example from the Norwegian healthcare sector demonstrate how individual and (inter-) organizational behaviours get inscribed into standards (Hanseth and Monteiro, 1997) with the aim of enforcing desired behaviour.

Standards are categorized along different dimensions, and as three major types (David and Greenstein, 1990): product, document (minimum quality) and compatibility standards. While the first concerns products, the second refers to information codes, and the last to processes in both production and consumption, of health information in our case (David and Greenstein, 1990; Farrell and Saloner, 1987; Besen, 1990). Standards can further be classified as
mandatory and voluntary, respectively being mandated by public authorities or emerging through a market process. De-facto standards emerge ex-post in the market as a result of a process of interaction of various agents related to the standard. De-jure standards are elaborated ex-ante either by committees and agreements or mandated by standard setting authorities (David, 1987; David and Greenstein, 1990). In functional terms, a further distinction has been drawn between standards that perform a reference function and consequently reduce transaction costs, and those that perform a compatibility function to enable technical coordination (Hanseth, Monteiro & Hatling, 1996).

Further, Sahay (2003) in the context of global software outsourcing argues the need also for practice based standards, drawing from the notion of ‘McDonaldization’ (Ritzer, 1996). Sahay argues how different tasks at various stages of the software development life cycle are separated and implemented in different geographic locations, coordinated through the use of information infrastructures and standardized development processes, methodologies and the use of technical components. This standardization, he argues, minimizes to a certain degree the heterogeneity inherent in distributed software development, and is significantly greater than when compared with other production activities which are coordinated across time and space.

Bowker and Star (1999) distinguish classifications and standards as two sides of the same coin. The distinction being that classifications are containers for the descriptions of events - they are an aspect of organizational, social and personal memory - whereas standards are procedures for how to do things - they are an aspect of acting and being in the world. Every standard, for example, generates an implicit classification scheme, which must eventually be standardized at least as an “ad hoc, limited to an individual or local community, and/or of limited duration” (Bowker and Star, 1999:15). Data warehousing techniques, which are largely used in HMIS (Braa and Sahay, 2012) follows the same approach. Definitions of data to be processed and stored are dependent on local socio-political norms and data warehousing applications are set of standards developed to host codified patterns of relations, which are in turn product of social, technical and political memories of organizations and individuals. In data warehousing terminology, “classification” is often replaced with the term “data dictionary”. A data dictionary is generated through local actions and interactions of actors and is codified in a standard way defined by metadata. Metadata determines formats, size, and properties of data and remains stable for longer time and can be applied to many locales,
while data dictionary is locale specific and subject to frequent changes depending on the socio-political environment.

Standards tend to be dynamic, reflecting their position with respect to broader organizational changes. Adaptation to changes requires infrastructures and standards to be flexible and aligned with the daily routines of organizations (Braa et al. 2006; Hanseth and K. Braa, 2000; Hanseth, Monteiro and Halting, 1996). The flexibility also allows a process of experimentation leading to improvements and building of users’ experience (Hanseth and Monteiro, 1997). The openness of infrastructures implies that the range and scope of standards must change over time and with it their relationships to other standards. These evolving processes make infrastructures heterogeneous in the sense that they are composed of different kinds of components, linked with communication, procedures and data standards. Standards as such play an important role in the design, development and evolution of IIs (ibid). Fujimura (1996) in her study of cancer research demonstrates how standards evolve as package of theories, methods, concepts and material objects of the research findings, created and shared among and by communities of researchers, fostering compatibility and interoperability. “Standardized packages” according to Fujimura are stabilized and generally accepted “facts”, which represent boundary objects with local research practices, restricting and enabling local actions (Fujimura, 1996). Data warehousing applications used in HMIS are also a kind of “standardized packages” built and tuned in the various contexts with varying level of economic, social and political constructs. Having many similarities and differences, such applications are often designed and developed in a modular way. Modularity of data warehousing applications provides flexibility where modules needed are picked from the package or version of module for a specific locale. Sharing core standards brings cost efficiency, time saving and avoiding possible design flaws, which have been tuned by other community members, to prevent “reinventing the wheel”.

Implementing standards also has cost implications, with an underlying principle being that as the user community adopting the same standard increases, the cost of its deployment will be lower due to stronger economies of scale. The more the standards are in use and widespread, the more it needs to take on a generic nature, which requires them to be situated in different local contexts of use (Ciborra and Hanseth, 1998). Localization creates tensions between global standards and local imperatives, requiring balancing of external forces and internal regulations respectively. The dilemma of the “context” (flexibility) and the “core”
(universality) in standards requires often a form of an external force that ensures consistency in applying the global requirements locally (Antonelli, 1994). Common examples of such forces are government standards (tax laws, accounting regulations), broad industry standards (HTML standards for WWW browsing, ISO standards for mechanical drafting), or those coming from powerful industry groups (EDI standards for data exchange).

Rolland and Monteiro (2002) described implementation challenges of global standards into local realities empirically based on an example of a global maritime classification organization with offices in more than 100 countries, including many in the developing world. The authors use the term information infrastructure rather than information system, to emphasize the complex and interlinked nature of the application, which need different methods of development and management. The distributed nature of use highlights the standardization versus localization debates, where universal solutions require to be customized to different socio-political contexts. While they call for finding a pragmatic balance between global standards and local adaptations, they do not go further in elaborating how this balance can be found. Data warehousing techniques and principles relating to modularization and “standardized packages” provide solid grounds for developing such a pragmatic balance, where global solutions (boundary objects) are brought to local realities. This helps to provide control and autonomy at the same time, emphasizing aspects related to the process of standardization: “While some of these “structures” will be implemented through technical specifications, others will appear more like informal agreements, institutionalized relationships and accepted practices” (Nielsen, 2006:52). In line with Nielsen (2006), I argue for a more detailed study of standardization process, specifically the analytical splitting of the social and technical components of the information system (within the larger II and institutional frames) possibly reveals patterns of recurring relations, which then could guide micro-processes of developing the required pragmatic balance. Working at various analytical levels is encouraged by different researchers (Callon et al., 1981; Currie, 2009), where individual (micro level) actions are constrained by organizational institutions (macro level) and represent a product of actions of group of actors.

Given this wide variation in definitions of standards, their types and scope and areas of use, it is important that I make explicit my perspective on standards as used in this thesis. I articulate my working definition of standard as: “an abstract and generalized or instantiated localized reproduction of certain aspects of practice, patterns of relations, knowledge,
behavior and description detached/attached from/to context of use, inscribed into artifacts, rules, guidelines and procedures to address a certain problem in the domain of interest”. In line with this, standardization is defined as “a process of negotiation and aligning standards into the context (scope) of use resulting in one of the standardization modes of generification, localization or contextualization”. A standard represents one out of many possible means to solve a problem, and thus always involves a process of negotiation and consensus building to enable its acceptance and implementation.

2.3. Standards, Health IIs and Developing Countries

The topic of standards and interoperability is not new in the domain of information systems, but in case of healthcare (especially in developing countries) it is still in a rather nascent stage. Beale (2004) differentiates HIS from other kinds of information systems in the way that they treat persons: "It is often asked: what is the difference between health IT and IT in other domains? One well-known answer is “the patient”. Systems in other domains such as banking and airline reservation have “customers” or “travellers” but these are grossly simplified abstract versions of a person. “Patients” in clinical systems are anything but: their biological and social complexity is manifested directly in clinical information, posing a far greater challenge than in other domains. ..." (Beale, 2004:301). Thus, healthcare standards inherit the complexity of human biology and their living environment as part of subject of their interests.

Over time, various standards have emerged in the health domain to address representations, data collection, storage, analysis and transfer of patient and facility based data. These standards embed clinical, procedural, and performance standards as well as including numerous classification schemes and terminologies (Timmermans and Berg, 2003). An example of a classification system is the International Classification of Diseases (ICD) - a terminology standard, implying its key function is to give stability of meaning over different sites and time (ibid, 2003). The contents of the ICD represents inscriptions of a series of technical, social, political and economic decisions taken at different moments in time (Bowker and Star, 1999). These global inscriptions represent a form of standard, which need to go through processes of local adaptations, while aligning with the purpose and context of use (Rolland and Monteiro, 2002). There are many occasions where there are different views on these standards, requiring local work-arounds and negotiations. For example, the cause of death as given on the death certificate by an attending physician is frequently not the cause of
death that enters into statistical records (Fagot-Largeault, 1989). The classifications entered, by their very nature and design, constrain the kind of story that the statistics tell (Bowker and Star, 1999).

Braa and Hedberg (2002) describe the process of developing new standards for health data in South Africa as a process of cultivation, in an incrementally evolving “bottom-up” process. This requires the aligning of actors by enabling the translation of their interests, through ongoing processes of negotiations. Their design strategy for the HIS is based on using the available infrastructure and enrolling the different actors to be involved in flexible negotiation processes while avoiding lock-ins and keeping the process open for future development. In another article, Braa and colleagues (2007) described the HISP strategy of flexible standards for the development of the HII and the associated standards. They abstract from the HMIS development and implementation experiences in three countries (South Africa, Ethiopia and Thailand), and identify complexity of the HII as a key challenge in the standardization process.

While pure technical and communication standards are easily accepted and data exchange is established, content and semantic standards of data may not be uniformly applied to all locales of an II. Meanings, volumes and formats of data require ‘work-arounds’ and necessitate greater standardization efforts. This is not easily achieved because of the socio-technical nature of knowledge embedded in such standards, as well as the number and variety of standards and their interrelations (Bowker and Star, 1999; Brunsson and Jakobsson, 2000; Fomin et al., 2003). In this regard, healthcare standards have their particularities coming from the complex nature of the healthcare system, including administration, financing, monitoring and healthcare delivery. This is further magnified by the fact that disease prevalence is locale specific and patient treatment can have many different routes based on its severity.

Braa and Sahay (2012) grouped standardization into three distinct and correlated levels depending on the type of standards and agreement of parties involved following Carlile’s (2004) framework for managing knowledge across boundaries. These are: syntactic/technical, semantic/data and organizational/political standards. As depicted in figure 2.1, the triangular model shows the increase of complexity and viewpoints of HMIS users from lower levels up. The authors illustrated the model with an example of telephone conversation. First, both sides should have compatible devices in order to establish conversation (syntactic/technical level), then they should speak the same or common language to understand each other.
(semantic/data level) and finally they should have interest in communicating such information to each other (organizational/political level). The highest level - organizational and political is more complex and accommodates differences between actors views, being a negotiation arena for reaching shared understanding and building an agreement on data standards, exchange and procedures. The figure 2.1 shows the complexity of standards across the different levels.

Health II represents the intersection of the technical and social dimensions of organizations, including standards, people, institutions, procedures and technologies. The HII is the focus of my analysis, helping to develop a more holistic approach of the standardization challenge. A HII perspective helps to provide a focus on the scaling challenge, of how the systems move across different administrative levels, the resources required, and what are the other socio-technical networks they need to link up in this process. The HII perspective thus allows the analysis of the processes of standardization, and their inter-organizational linkages. Since a HII by definition spans across time and space, it allows the researcher to observe standardization process in various settings. Since the II emphasizes the heterogeneity of networks, and the negotiation processes that surround it at multiple levels (Rolland and Monteiro, 2002), it enables a rich analytical perspective. The next section is dedicated to Institutional theory, which broadly covers organizations and their institutional constructs.
2.4. Institutional Theory and HII

The process of IS implementation can also be seen as the conception and institutionalization of information systems (Silva and Backhouse, 2003). The institutional theory perspective helps provide a broader understanding of information systems from an organizational point of view. For example, it is important to understand the interplay between the various stakeholders in HMIS standardization process; giving due attention to the social dynamics of the standardization process; understanding the nature of standards in relation to the roles stakeholders play, and the mechanisms driving the implementation and diffusion of the information systems.

Institutional theory has been successfully applied in many disciplines such as economics (Aoki, 2001; North, 1990), sociology (Powell and DiMaggio, 1991; Streeck and Thelen, 2005), and political science (Immergut, 1998; Thelen, 1999). In IS research too, IT implementation in organisations has been subject of study by researchers from the domains of both organisation studies (Bijker and Law, 1992; Fulk, 1993; Prasad, 1993; Thomas, 1994) and information systems (Lucas, 1975; Bostrom and Heinen, 1977; Franz and Robey, 1984; Ginzberg, 1981; Robey and Sahay, 1996; Sahay, 2003, Noir and Walsham, 2007). These researchers have focused on understanding human behaviour in and between organisations and individuals, and the role of IT in shaping these relationships (Orlikowski and Baroudi, 1991). Orlikowski and Barley (2001) further argues that institutional analysis can help information systems researchers understand “how technologies are embedded in complex interdependent social, economic, and political networks, and how they are consequently shaped by broader institutional influences” (Orlikowski and Barley, 2001: 154).

Organizations are guided and constrained within their institutions, as Barley and Tolbert put it: “organizations are suspended in a web of values, norms, beliefs, and taken-for-granted assumptions” (Barley and Tolbert, 1997:93). These values, norms, beliefs and assumptions represent institutions - social structures that guide and constrain organizational and individual actions (Scott, 2001). Institutions thus represent “multifaceted, durable social structures, made up of symbolic elements, social activities, and material resources” (Scott, 2001:49), which are self-reproducing and repetitive in nature, thus exhibiting stability and order. Although institutions provide stability and order, they undergo changes, both incremental and revolutionary. From this standpoint, institutions are not only the ‘property’ or the state of the
existing social order, but also represent ‘processes’, including relating to institutionalization and deinstitutionalization (Tolbert and Zucker, 1996).

There are many applications of institutional theory in the context of healthcare, including in recent years about the role of technology in these settings. Currie and Guah’s (2007) application of institutional theory as a conceptual lens to examine the National Programme of Information Technology project and the modernisation of the National Health System (NHS) in the United Kingdom is very instructive in the use of the theory. Currie and Guah used institutional theory to evaluate the wider organisational factors that influenced the modernization programmes, in the light of the complex and dynamic processes involved in the transformation of the NHS. Kimaro and Sahay (2007) drawing on institutional theory, proposed a theoretical framework that identified an organizational field in the context of the Tanzanian HIS. They defined formal and informal constraints arising in the co-relation of these entities in the organizational field in the process of decentralization of healthcare delivery. Applying this framework to the empirical data they identified gaps between the formal and informal routines that created a conflicting situation, negatively affecting the reform process. Such conflicting situations within and across health organizations at different levels are potential sources and causes of change (Piotti et al., 2006). These authors also argued for a better conceptualization of technology in the study of organizational fields by combining institutional and II theories.

The use of institutional theory has also been quite popular with researchers in examining the concept of inter-organisational electronic data interchange (EDI) standards. For instance, Damsgaard and Lyytinen (2001) have used institutional theory to study the different diffusion patterns of EDI in Finland, including alternative adoption patterns that operate beneath specific institutional incentives and programmes. They probe individual organisational cases within specific industrial contexts to dissect interactions between multiple factors that are likely to affect the diffusion of EDI. In a separate study, the same authors examined the impact of intermediating organisations (such as industry associations), and how they have contributed to advancing the EDI standard diffusion process in the grocery sector of Hong Kong, Denmark and Finland. While the trajectory of EDI adaptation and diffusion in all three countries were different, the intermediating organisations played critical and varying roles in the adoption and institutionalization of such technological innovations. A key analytical point
has been the role of local contingencies, history, and the strategies adopted by the trade and industry associations (Damsgaard and Lyytinen, 2001).

2.4.1. Organization Field and Institutional Logics

Studying the dynamics of global/local interplay of HMIS standards requires an analytical lens to examine various levels of institutions in organizational settings, “… no concept is more vitally connected to the agenda of institutional processes and organizations than that of organization field. […] the concept of field – both as unit and level of analysis – figures sufficiently large in institutional approaches to organization to merit extended attention” (Scott, 2008:181). The concept of organizational field incorporates all levels of organizational analysis, including the individual organization, organization set, and organization population (Porac, Thomas, & Baden-Fuller, 1989) that directly interact with one another and influence each other (Greenwood, Sudaby and Hinnings, 2002).

A founding definition by DiMaggio and Powell of an organization field is "sets of organizations that, in the aggregate, constitute an area of institutional life; key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products.” (1983: 148-149). Scott (1994) added the idea that patterns of interaction between organizational communities and their shared systems of meaning. These meaning systems establish the boundaries of each community of organizations, defining its membership, appropriate ways of behaving, and appropriate relationships between organizational members (Lawrence, 1999).

Collective beliefs are seen as emerging from processes of repeated interactions between organizations. Organizations develop categorizations of their exchanges, which achieve the status of objectification and thus constitute social reality. Organizations, initially at least, behave in accordance with this socially constructed reality because doing so helps to reduce ambiguity and uncertainty. Reciprocally shared understandings of appropriate practice permits ordered exchanges (Greenwood, Sudaby and Hinnings, 2002) within a framework of an institutional logic. Institutional logics constitute rules and conventions of organization field (Owen-Smith and Powell, 2008), becoming organizing principles and receipts for action. They have instrumental, normative and cognitive implications (Friedland and Alford, 1991; Thornton, 2004), providing rationales for action. Multiple competing logics in an organization field may trigger conflicts resulting in change or new account of activities, and their consistency brings stability to an organization field (Owen-Smith and Powell, 2008).
The concept of institutional logics has been used to describe contradictory practices and beliefs within institutions (Alford and Friedland, 1985; Jackall, 1988; Thornton and Ocasio, 2008), which create conflicting situations and consequent change processes resulting in weakening and erosion of institutions, deinstitutionalization and their reinstitutionalization (Oliver, 1992). Institutional logics provide the analytical link between individual agency and cognition and socially constructed institutional rules and practices (Thornton and Ocasio, 1999), which can provide insights on why there may be deviations from the “taken for granted” assumptions of bureaucratization (DiMaggio and Powell, 1983).

Cavalluzzo and Ittner (2004) discuss how public organisations in the USA implement management control systems to meet governmental requirements but do not actually take advantage of these systems for internal improvements. The authors use institutional theory to demonstrate how inadequate perceived benefits realised from mandated organisational changes in public organisations tend to be symbolic, but have little effect on actual use of the systems. Butler (2003) uses institutional theory to explain how the commitments of social actors influence and shape the development of web-based IS. Butler describes a high degree of ‘institutional tension’ between the various actors involved in the development of web-based systems, mainly because of established commitments to their communities of practice and the need to maintain existing power relationships. Chatterjee and colleagues (2002) draw from institutional theory as a conceptual lens to examine the impacts of specific institutional factors (such as top management advocacy, strategic investment rationale and coordination) in the adaptation of Web technologies into e-commerce strategies and activities in firms. In particular, the authors test the relationships among these factors using quantitative measures and their impact on the organisational assimilation of Web technologies.

Despite similarities and being part of the same organizational field, organisations often deploy different patterns of action to similar set of organisational routines (Pentland et al., 2010). Studying log records in invoice processing routines in four organisations in Norway, Pentland and colleagues argued that using the same software application, these organisations adopted different patterns of use. This could be explained by the cultural-cognitive dimension of institutions, which influences individual and group interpretation of actions.

2.4.2. Carriers of Institutions

Organization fields are “[…] formed around the issues that become important to the interest and objectives of a specific collective of organizations” (Hoffman, 1999:352). These
objectives then need to be propagated among field members, aligned and acted upon. Institutions of any type, whether normative, regulative or cultural-cognitive are communicated by various vehicles or “carriers” (Jepperson, 1991:150). Scott (2008) distinguishes four types of institutional carriers: symbolic, relational, routines and artefacts (Scott, 2008:140). Institutional changes are largely affected by institutional carriers, which represent fundamental mechanisms that allow transfer of ideas through time and space and who and what are transporting them.

Travelling across contexts, ideas, artefacts and standards get altered, modified, and combined with other ideas and objects. Sahlin-Andersson describes the process this way: “the models are told and retold in various situations and told differently in each situation” (Sahlin-Andersson, 1996:82). How this transformation takes place is dependent significantly by the type of carriers (Scott, 2008).

According to D’Adderio (2003), knowledge and practices embodied into software standards are codified representations of routinized patterns of work performed by actors. In such standardization processes, informal patterns are in danger of being omitted, creating failure points for cross-contextual implementation or localization of these standards (Jarulaitis and Monteiro, 2011). She demonstrates how the implementation of new ICTs failed to re-establish informal patterns of communication, and enabled the emergence of new patterns of communication. D’Adderio concludes that following the introduction of new software, evolution of routines demonstrates mechanisms of new knowledge creation and reproduction at the organisation level (D’Adderio, 2003).

### 2.4.3. Institutional Theory and Standardization Process

The problem of bridging the gap between micro and macro perspectives has received considerable attention in studies of management, policy, economics, and social organization (Callon et al., 1981; Fomin et al., 2000a). What is likewise important is the reciprocal interaction between levels, where macro structures in society are bridged by organizational fields to micro structures in organizations or even “down” to the individual actor level. Institutional creation and diffusion thus takes place, where top-down processes allow higher level structures to shape the structure and action of lower levels, while bottom-up processes shape, reproduce and change the context within which they operate (ibid., :190-195). Scott’s argument is mirrored by Currie (2009) who encourages information systems researchers to work with multiple levels and stakeholders which is fundamental to institutional theory.
Currie argues: “IT-related constructs, such as adoption intention, assimilation and implementation, without considering wider environmental and inter-organizational levels” are problematic, because important tenets of institutional theory are based on multi-level and multi-stakeholder analyses (Currie, 2009: 66).

From an organizational viewpoint, standards align diverse interests of participating groups (Fomin et al., 2000b; Hanseth et al., 1996). In fact, interests of these social groups (government organizations, engineers, entrepreneurs, consumers, etc.) must be aligned if the development of the technological system is to proceed (Latour, 1999). Standards provide a means for system builders and entrepreneurs to share their perspectives, and to gain understanding of how the technological potential can be leveraged to meet diverse ends. By doing so, participating groups can better negotiate the desired technical and economic properties of the technology (Bekkers and Lirotard, 1999). Hence, standards inscribe and embed large socio-technical networks of developers, users, and government institutions, and provide a powerful means to analyse the relational aspects of infrastructures.

Many theories give “the state”, or political actors such as judges and politicians, an independent role in the rule-making process. Alston (1996:26-7) outlines the general framework: “Institutional change can be thought of as the result of supply and demand forces in a society. We can think of demanders as constituents and suppliers as the government ... Institutional change results from the bargaining actions of demanders and suppliers.” Here, we might imagine a continuum of possible theories, depending on the degree of autonomy attributed to political actors. On one extreme, such actors can be viewed as simply reflecting the interests of groups they belong to, so that their individual interests are relatively unimportant and the political process remains essentially a battleground in which interest groups compete to mould formal rules to their own advantage. I use the concept of incentives as a driving mechanism in understanding the global/local interplay of standardization and institutionalization of new norms and procedures in the HMIS. This serves as an important symbolic (and also material) representation of group and individual interests.

The concept of incentive is mainly used to denote purposeful action of individuals and as part of social groups, choice of which is guided by expectation of some sort of rewards (Armstrong, 2002). Incentives can be positive or negative depending on an individual’s perception of changes resulting from particular actions taken from within a set of rules in a particular physical and social context (Ostrom, Schroeder, & Wynne, 1993; Campbell, 1995).
Social arrangements have influence on the actions of individual members, thus examining practices, rules and norms at social level are important. For example, in healthcare, “pay for performance” is a mechanism being increasingly used by healthcare providers for improving quality of care and at the same time providing incentive to medical practitioners (Garber, 2005).

The Institutional Analysis and Development (IAD) framework (Kiser and Ostrom, 1982; Oakerson, 1992; E. Ostrom, Gardner, and Walker, 1994) makes extensive use of the concept of incentives to examine rule structures and collective choices related to the management and use of common pool resources. Institutions, serving to streamline incentives in situations where problems of collective action emerge, are based on a convergence of expectations. Such expectations can be undermined when poor coordination among participants makes the efforts an unreliable organizational resource.

Integrating past research from the fields of public administration, institutional economics, and policy analysis, Ostrom and colleagues (1993) show how institutional arrangements and the incentives they generate can help or hinder development efforts. The authors present a method for systematically comparing alternative institutional arrangements for the development of rural infrastructures. Their analysis reveals the special strengths and weaknesses of polycentric as compared to the centralized or decentralized institutional arrangements. Descriptions of a variety of infrastructure projects - including roads, bridges, and water resources - in diverse geographical settings are used to illustrate “institutional incentives”, contributing practically to the understanding of sustainable development, infrastructure maintenance, and institutional arrangements.

2.5. The Proposed Analytical Framework

This chapter has reviewed the theoretical concepts drawn from the II perspective and institutional theory as well as from relevant literature related to standards and standardization. My proposed theoretical framework elaborates upon the tripartite relationship between actors, standards and the problem addressed by the standards, reflecting its content or topic (from now on I use the term ‘topic’). These relationships are guided by formal rules and informal constraints (North, 2001) embedded into these components and its context-sensitivity can give rise to multiple contradictory influences in the process of standardization. Key to this relation is the diversity and heterogeneity of the member entities, both humans and non-humans, the nature of the relationships and their distinctive attributes. A standardization
process as was mentioned earlier, involves various actors including health managers, IT specialists, medical doctors, and funding agencies with their different interests. This diversity supports alternative interpretations, for example standards as seen by developers are not the same to the health manager or the medical doctor.

Building large scale IIIs requires complex set of social, technical and organizational decisions to be taken (Hanseth, 1996), including relating to standards and standardization. Such information systems became carriers of institutions, provided that decisions and new procedures are made at a high level and implementation is propagated to lower levels. Conflicting institutional logics create tensions at multiple levels, including at that of the individual actors. Actors with varying level of expertise have different understandings of the standardization process guided by their institutional and individual incentives. Actors’ use of standards depends directly on their cognitive, social, cultural, and institutional structures. From the other side, standards are often built a priori with predefined assumptions of specific configurations of actors, tools, and actions, which vary significantly with different contexts (Millerand and Bowker, 2009). This necessitates the coordination of work among different social worlds, for example of health managers, standards development teams, and health statisticians, all of whom are concerned with the implementation of HMIS.

In order to explore this aspect of multiplicity of standards and actors, I use the concept of “facets of infrastructure”. The idea here is to divide the parts of ICT development and implementation environment into smaller correlated facets from technological, organizational, technological and other considerations. This helps to reduce complexity and at the same time follow a holistic approach to the II development. Another use of “facets of infrastructure” is that small local problems (within individual facets) could be solved internally, not disturbing the larger system and institutions. Thus, a set of related actors, standards and topics could be grouped, managed and studied in a certain level of isolation from the rest of II processes, to help identify the consistency of actions and their outcomes.

Different viewpoints of actors create tensions for which they start negotiations to try and reach a consensus. In the standardization process, actors are often confronted with constraints and affordances coming from: 1) installed base, 2) global standards, and 3) the current local practices including of actors having similar constraints. Actors seek incentives, both material and moral, from the actions they perform in balancing between these constraints. If incentives received are positive and a group of actors deliberately accept the same line of decisions, it
could be effective in helping to acquire a high level of acceptance and legitimacy (Markus and Gelinas, 2006). Negative incentives, representing lack of effective consensus among actors, can lead to further negotiations, local workarounds (Rolland and Monteiro, 2002) or even the abandonment of the standards.

My proposed theoretical framework is depicted schematically in figure 2.2 below. The inner circles depict the tripartite relations among actors, standards and topics. Combining the family of standards, actors and topics together we can see the holistic picture of relations between institutions, II and the social reality of the context (outer circles). This perspective helps to formulate the following questions to focus the research questions that were presented in chapter 1:

1. What are the facets of infrastructure which shape the interplay between global standards and their local adaptation?

2. What is the nature of the tripartite relation between actors, standards and the topic addressed by the standards? And how does this shape the standardization process?

3. What are the specific and distinctive patterns in such relations that could help in developing strategies to deal with challenges and benefit from the opportunities offered?
This perspective permits a better understanding of the social and organizational dynamics of global/local interplay of standards during development and implementation of large-scale IIIs. Implementing global solutions often follow institutional changes that are introduced at a central level which are then negotiated and appropriated by actors at lower levels. Organizational and institutional arrangements (characterized by routines, standards, norms, and politics) mediate the implementation and the use of the information systems, which in turn contributes to the restructuring of these arrangements. Analysis of the different aspects of these relationships of actors, standards and topics is further explained in chapter 6.
Chapter 3

3. Research context

This research was conducted primarily in the Republic of Tajikistan, and partly in (the Republic of) India. In Tajikistan, two decades of independence after the Soviet breakdown have changed the political and socio-economic landscape and trajectory of the country’s development. India’s socio-political transition from pro-Soviet to market economy (also starting 1991) was comparatively smoother. New political settings, emergence of private property and market economy rules and regulations have affected all areas of everyday life, including public health care. For that reason, it is important to provide a brief overview of the latest political and economic developments in the countries along with its geographical location and demographics, which helps to paint the landscape of the context and contribute to a better understanding of the object of my research. An overview of the public health care system of Tajikistan is presented followed by a discussion of the ongoing reform processes in health care policy and management with a particular focus on the HMIS. Then I briefly introduce India’s healthcare system with a limited scope of the context of hospital management in the state of Himachal Pradesh, where I was involved in design, development and implementation of a Hospital Management Information System (HospMIS).

The chapter is divided into 6 sections. In the first section, the political and demographic context of Tajikistan is presented. In section 3.2, the overall health system of Tajikistan is discussed providing detailed information of the Ministry of Health (MoH) administrative divisions and their roles and responsibilities with the health system, including the HMIS. Section 3.3 discusses the Civil Registry Office (CRO) structure of Tajikistan, its role in the healthcare system, along with an overview of existing problems and challenges. This is followed by a brief overview of the Himachal Pradesh State case in India and its attempt to improve healthcare service delivery at facility levels in Section 3.5. Finally in section 3.6, I conclude with a discussion on key challenges and gaps in the HMIS of Tajikistan and HospMIS in Himachal Pradesh.

3.1. Political and demographic context of the Republic of Tajikistan

The Republic of Tajikistan is a landlocked country located in Central Asia bordering Afghanistan to the south, Uzbekistan to the west, Kyrgyzstan to the north, and China to the
east. Figure 3.1 shows an administrative map of Tajikistan and its location in Central Asia, its main roads and rivers. 93% of Tajikistan’s land is high mountains, thus making transportation and other forms of communication difficult. As of 2011, the population of the country was 7.6 million (Census 2011, SSA) with an annual growth rate of 1.37% and around 80% of population living in rural areas (World Bank, 2011).

Figure 3.1. Administrative Map of Tajikistan

The Republic of Tajikistan was formed in 1929 as a constituent state of the Soviet Union and is currently amongst the least developed of the former Soviet Republics. Tajikistan announced its independence on 9th September of 1991 shortly after the collapse of the Soviet Union. Following independence, ideological and regional conflicts broke out into a civil war,
which lasted till 1997. During the civil war, reported as one of the most violent conflicts in the post-Soviet countries, approximately 520,000 people lost their lives and more than one million fled to other countries (EIU, 2006). According to a report by the World Bank (2007), damages to public and private property were significant, amounting to US $7 billion. This devastating civil war continued the prolonged economic depression, and 83% of the population in 1997 were reported to be below the poverty line, which in 2009 was down to 47% (WB, 2007). Significant improvements in poverty reduction in a short period of time have taken place, with increased stability contributing to growth of public income.

In 1994, a new constitution was adopted defining Tajikistan as a presidential and secular state. Administratively, Tajikistan is divided into five main divisions: Khatlon (25 districts), Sogd (18 districts), Region of Republican Subordination (13 districts), Autonomous Badakhshani Kuhi (7 districts), and the capital city of Dushanbe (4 districts) (see Figure 3.1). The lowest level of administrative divisions are Jamoats (municipalities), subordinating to districts.

Tajikistan, as other former Soviet republic countries, faced a "spontaneous transition" from a planned to an open market economy with inherent inefficiencies, as the country lacked the organization, institutions and culture that characterized established Western democratic economies (Braguinsky and Yavlinski, 2000). Many existing economic and infrastructure links were abandoned, like the common Central Asian power grid linking all four countries of the region for load balancing of power supplies. The united power grid was broken by Uzbekistan and followed by other countries in the region. This contributed to an already adverse situation with respect to power supply in Tajikistan, and with it, escalated also political tensions with Uzbekistan. Uzbekistan tried to block Tajikistan’s initiative to build a hydro-power plant to eliminate power shortages in the country and to also supply excess energy to other neighbouring countries like Afghanistan and Pakistan. Uzbekistan motivated the opposition with possible ecological effects the new dam may have in the region, which has till date been proved to be minimal (WB, 2012).

Table 3.1 shows some of the human development indicators for selected countries (highest ranked, bordering and lowest ranking countries selected for comparison) before the Tajikistan civil war – 1990 and also as of 2011 (most recent available data).
Table 3.1. Human Development Indicators (adapted from UNDP reports for 2011 and 1990)

<table>
<thead>
<tr>
<th>HDI rank 2011/1990</th>
<th>Country</th>
<th>Human Development Index (HDI)</th>
<th>Life expectancy at birth (years)</th>
<th>Mean years of schooling (years)</th>
<th>Gross National Income (GNI) per capita (Constant 2005 PPP$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3</td>
<td>Norway</td>
<td>0.943</td>
<td>81.1</td>
<td>12.6</td>
<td>47,557</td>
</tr>
<tr>
<td>66/37</td>
<td>Russian Federation</td>
<td>0.755</td>
<td>68.8</td>
<td>9.8</td>
<td>14,561</td>
</tr>
<tr>
<td>68/54</td>
<td>Kazakhstan</td>
<td>0.745</td>
<td>67.0</td>
<td>10.4</td>
<td>10,585</td>
</tr>
<tr>
<td>101/101</td>
<td>China</td>
<td>0.687</td>
<td>73.5</td>
<td>7.5</td>
<td>7,476</td>
</tr>
<tr>
<td>102/66</td>
<td>Turkmenistan</td>
<td>0.686</td>
<td>65.0</td>
<td>9.9</td>
<td>7,306</td>
</tr>
<tr>
<td>115/80</td>
<td>Uzbekistan</td>
<td>0.641</td>
<td>68.3</td>
<td>10.0</td>
<td>2,967</td>
</tr>
<tr>
<td>126/83</td>
<td>Kyrgyzstan</td>
<td>0.615</td>
<td>67.7</td>
<td>9.3</td>
<td>2,036</td>
</tr>
<tr>
<td>127/86</td>
<td>Tajikistan</td>
<td>0.607</td>
<td>67.5</td>
<td>9.8</td>
<td>1,937</td>
</tr>
<tr>
<td>134</td>
<td>India</td>
<td>0.547</td>
<td>65.4</td>
<td>4.4</td>
<td>3,468</td>
</tr>
<tr>
<td>145</td>
<td>Pakistan</td>
<td>0.504</td>
<td>65.4</td>
<td>4.9</td>
<td>2,550</td>
</tr>
<tr>
<td>172</td>
<td>Afghanistan</td>
<td>0.398</td>
<td>48.7</td>
<td>3.3</td>
<td>1,416</td>
</tr>
<tr>
<td>187</td>
<td>Congo (Dem. Rep. of)</td>
<td>0.286</td>
<td>48.4</td>
<td>3.5</td>
<td>280</td>
</tr>
</tbody>
</table>

Table 3.1 clearly indicates that Tajikistan and Kyrgyzstan were more adversely affected with respect to their economic growth as compared to other neighbouring countries. Despite being more politically stable, the neighbouring Kyrgyzstan has an equal gross national income (GNI) as Tajikistan. The transition process, particularly the privatization of public enterprises, lack of knowledge of open market economy, and the immigration of qualified experts from Tajikistan and Kyrgyzstan to other more successful countries have contributed to this situation (Dana, 2000). During and after the civil war in Tajikistan, many left to the Russian Federation, Kazakhstan and other countries as labour migrants (Olimova and Bosc,
According to the International Labour Organization (ILO, 2010) there are about 2 million Tajik migrants in Russian Federation and their annual remittance to Tajikistan in 2008 was US$ 2.6 billion, which was 49% of the gross domestic product (GDP), and thus significantly contributing to the national economy.

The economic downturn, civil war and high migration rates have also contributed to further deterioration of the public health conditions. This is heightened with a rampant rise in communicable and non-communicable diseases, and an overall worsening of access to health services, particularly for the poor (Khojamurodov and Rechel, 2010). While Tajikistan had an excessive number of medical professionals and an oversized network of health facilities in the early 1990s (McKee et al., 2000; Geddik et al., 2002), the situation changed dramatically in the years after independence. Damages brought to the health facilities, and the migration of doctors led to their non-functioning (Mirzoev et al., 2007). The government expenditure on public health care declined (Vargas and Clary, 2002; Mirzoev, 2004) and remains the lowest in the WHO European region (Khojamurodov and Rechel, 2010). This makes the country heavily dependent on external aid (Cashin, 2004). The largest portion of health expenditure is covered by formal and informal out of pocket payments that patients are forced to make for services that they receive in public health facilities. (Falkingham, 2004; Cashin, 2004). In 2006, 70% of healthcare expenditure was covered by private (formal and informal), 16% by government and the remaining 14% through donor funding (Republic of Tajikistan, 2006).

To summarize, Tajikistan’s transition after independence was challenged by major political tensions, civil war and economic downturn during the first decade. The second decade of independence was remarkable with limited economic growth and a gradual shifting from relief to development. This helped to create a more favourable climate for reform of the public sector. New initiatives towards better health and education were initiated, which required changes in institutional and organisational arrangements, governance, financing and delivery of services.

3.2. The Health System of Tajikistan

It has always been a priority for the national government to provide high quality and affordable health services to the population. During the Soviet period, such decisions were centrally developed in Moscow and national ministries had marginal influence on the process, except to follow up on its implementation (McKee et al., 2002). After the fall of the Soviet Union, Tajikistan had to develop its own national strategy for health, making the MoH
as the key decision maker (McKee et al., 1998). This transformation in the midst of the turbulent civil war was a major challenge in terms of building capacity for policy-making (McKee et al., 1998, 2002; Mirzoev, 2004, 2007). There was a reorganisation of the Ministry’s structural and administrative hierarchy, where new organizational rules replaced old ones, including inter-ministerial linkages. Core to this reorganization was the shift from centralized towards decentralized management with the aim to give more budgetary control to lower level organizations. The state budget of Tajikistan was compiled by the Ministry of Finance and approved by Majlisi Oli (Parliament), with the MoH playing a recommendatory role. The Ministry of Finance distributed budgetary funds for the health sector from central government to provincial governments and funds were further allocated to provincial and districts health departments (see Figure 3.2 below).

The Provincial health department (PHD) is responsible for health care service delivery at the province level and directly reports to MoH, but with limited budgetary control, except to provide medical supplies and equipment. The PHD has direct control over the district health departments, giving them advice on health matters, managing health policy and planning, but with limited budgets to support them. The district health departments are directly financed from the provincial Finance department of the Ministry via the district Finance department. The PHD has a limited number of staff, mainly dedicated to inspection of health policy implementation (Khodjamurodov and Rechel, 2010), with limited influence on HMIS.

Until recently, structural changes happened mostly at the national and provincial levels with little impact on the district and peripheral levels. District health was managed by the head of the central district hospital and his/her deputies, who were in charge of hospital services and outpatient facilities. Financing of the district health was managed by the central hospital, which had the accounting department working closely with the district finance department. This schema of financing was aimed at promoting hospital centric health services delivery, paying more attention to curative care, while neglecting primary healthcare. A significant proportion of the budget – 60% was allocated to hospitals in 1999 and 56% in 2003 (Cashin, 2004a). To strengthen preventive healthcare, the MoH reorganized health care provision with a new governance mechanism including the establishment of district health departments starting in 2011 (MoH Order #41). Since public funding of health care was insufficient compared to requirements, 76.2% of funding came from informal out of pocket payments (WB, 2007). The MoH divided primary and secondary health care at the district level into
separate divisions having their own budgets, giving higher priority to primary health care (see Figure 3.3). Also, the appointment of head of district and province health departments were shifted from local government administrations to the MoH with a decree of Parliament (Number 652 from 18th May 2009). This “Amendment to the law on public health care in Tajikistan” gave the MoH more power to manage its regional divisions.

The organizational chart of the health system of Tajikistan starts with the MoH, coming under the Prime Minister’s office run by the President and Parliament. The MoH closely collaborates with the MoF and the Ministry of Education (MoE). The MoF is responsible for delivering public funding of health facilities at all levels through local governments (hukumats), while the MoE manages medical educational institutions and colleges and is responsible for personnel training. Figure 3.2 below shows the organizational chart of MoH Tajikistan in more detail.
The healthcare service delivery of Tajikistan strictly follows its administrative divisions consisting of three major levels: national, provincial and districts. Each of the levels has
various facilities directly linked to them. MoH has seven directorates, six departments and
seventy four national centres of various purposes, including scientific, educational, treatment,
pharmacy, statistics and publishing. The provincial level of the MoH runs the hospitals at that
level and plays an inspection role for the district levels. The district level is the largest part of
the health service sector, composed of the district central hospital, PHCs, municipal hospitals,
and village health centres.

3.2.1. Data Collection and Reporting Systems

Data collection starts from the peripheral facilities at various levels of public healthcare; from
village health centres to national hospitals. Data is collected on patient visits to PHCs,
hospitals, outreach, and various campaigns. There are 259 forms for recording primary care
data, including 25 forms being used in hospitals, 54 in PHCs, 34 in both PHCs and hospitals,
84 forms are used by epidemiology service and other 62 forms by various laboratory tests and
formal and legal reporting. All these forms are designed to use ICD-10 as the standard for the
classification of diseases, but those which are rarely used in practice.

These data are then compiled into reporting forms for upward reporting. In addition to this
mandatory data collection and reporting forms, there are other donor supported vertical
reporting systems organized by specific programmes like HIV/AIDS, Tuberculosis or
national services like sanitary and epidemiology. While data are collected on a daily basis
and compiled monthly into the log books; most of these data are reported annually. 37
reporting forms out of 41 are annual, 2 are quarterly and the other 2 are monthly forms.
Varying reporting periodicity and programme specific reporting have historically created
fragmentation of data across the various healthcare programmes. Addressing them is a key focus of national reform efforts.

3.2.2. Healthcare Reforms

Tajikistan has made profound success in reforming its healthcare system to respond to urgent needs by adopting new policies. Although progress made in the past two decades of independence are significant, there are still many issues that need to be addressed at different levels of the health system (Khodjamurodov and Rechel, 2010), including strengthening of the HMIS.

Analysing healthcare reforms in the past two decades, Khodjamurodov and Rechel (2010) have identified three distinct stages in the historical timeline of health sector reforms in the country. These include:

The First stage (1993 - 1996) was dedicated to the formation of short and long term strategies for health care reforms.

The Second stage (1997 - 2001) was primarily concerned with the implementation of consecutive action plans with regards to above policies, a process which was sub-optimal due to resource constraints.

Stage three (2001 - onwards) is mainly regarded as the implementation period. MoH in collaboration with international partners like European Commission, World Bank, WHO, UNICEF, USAID, the German Government, the Asian Development Bank, the Aga Khan Foundation, the Swiss Agency for Development and Cooperation and the Swedish International Development Cooperation Agency, started to implement various projects. These projects were aimed for strengthening the different aspects of the healthcare sector, including primary health care, hospital care, institutional capacity, medical information systems, involvement of the public, immunization programmes and health financing mechanisms. In this stage, the issue of fragmentation, something inherent in the national healthcare system, and aggravated by the escalation of donor funding of specific programmes, was one of the key challenges in ushering in reform. State sanitary services under the MoH, TB hospitals and many other parallel health service facilities run by other ministries have been organized in a largely vertical fashion. The government realized the need for coordination of donor funded projects, to efficiently allocate resources and to assure sustainability of efforts
(Republic of Tajikistan, 2005a) and in 2008 they created a department for the coordination of reforms.

Table 3.2 below summarizes various events and significant actions taken place during three stages of healthcare reform in Tajikistan.

**Table 3.2. Three Stages of Health Reform in Tajikistan**

<table>
<thead>
<tr>
<th>Reform stage</th>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993 - 1996</td>
<td>1994</td>
<td>An essential drug list was adopted</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>Policy for “Health care reform in the Republic of Tajikistan for 2001” was adopted</td>
</tr>
<tr>
<td>1997 - 2001</td>
<td>1997</td>
<td>Private medical practice was legalized</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>National drug policy was adopted</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>The Faculty of Family Medicine opened</td>
</tr>
<tr>
<td>2001 - onwards</td>
<td>2002</td>
<td>Two strategic documents for the reform of the Tajik health system were launched – the Poverty Reduction Strategy Paper and the Conception of Health Sector Reform</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>Some policy-making authority was delegated to the province administrations.</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>The National Drug Procurement Agency was established to ensure quality control of imported drugs</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>A state-guaranteed benefit package of services and official co-payments was introduced countrywide, but suspended after two months</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>The basic benefit package was reintroduced in four pilot districts, with the simultaneous introduction of per capita financing in eight pilot districts</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>Strategic plan of health information system development for Tajikistan – “HIS Strategic Planning for Sustainable Results for 2012-2015”</td>
</tr>
</tbody>
</table>

A major event that gave rise to many efforts listed above was the amendment to the National Constitution that removed the clause stating “free guaranteed health care service” for citizens. The amendment was approved in June 2003 following a national referendum, recognizing the mutual responsibility for government and citizens towards health care delivery (WB, 2004b).

One initiative following the amendments in the National Constitution was the Guaranteed Benefit Package (GBP) or the so called “basic benefit package”, introduced on August 1, 2005 throughout the country. This sought to ensure equal access to health care and eliminate
out of pocket informal payments. GBP was a form of insurance based on co-payment schema, with both the government and patients having to share the cost of service, with some categories exempted, while others (such as foreign citizens) having to pay for services partly or in full (Rechel and Khodjamurodov, 2010). Despite being successfully piloted in two districts (Varzob in DRD and Dangara in Khatlon), the GBP failed to perform as expected and was halted shortly after two months in October 2005.

In June 2007, the GBP was re-launched as a pilot project in four districts (Dangara, Rasht, Spitamen and Tursun-Zade), trying to incorporate lessons learned from the previously failed attempt. The 2008 survey showed that GBP had sufficiently decreased out of pocket payments in pilot districts, but did not solve the problem with respect to remuneration of medical personnel (Bobokhodjaeva et al., 2010). The MoH postponed the rollout of the GBP from 2011 to 2014 based on the progress and difficulties experienced in pilot sites.

Another significant reform initiative was to strengthen HMIS with an objective to develop tools for monitoring and evaluation of other reform initiatives and strengthening healthcare management in general. Monitoring was performed by measuring indicators, calculation of which in most cases was based on population data. The next section discusses the Civil Registry System (CRS) system, which records and reports on demographics.

### 3.3. Civil Registry Office – National Registrar of Demographics of Tajikistan

A health information system needs to draw upon a strong civil registration system that provides full coverage of birth and death registration, including accurate medical certification of birth, death and the causes of death. This then becomes the main source of information to generate key demographic and health indicators including crude birth rates, crude death rates, age and sex specific death rates, life expectancy, patterns of causes of death and disease prevalence or incidence for the catchment population. This requires the generation and use of reliable indicators to measure performance. The CRS provides necessary inputs to the State Statistics Agency to update the inter-census population by age and sex estimates which are used as denominators in many, if not most, of the core health indicators. It makes sense, therefore, for serious investments to be made by the health sector to ensure that the vital registration data provided by the CRO to the HIS is as complete, accurate and timely as possible.
In the past, several assessments have been done on vital registration data from the CRS in Tajikistan. The HMN Assessment rated the CRS as “highly adequate” (HMIS II, 2009, see Table 3.3). However, three in-depth studies carried out in 2011 present less favourable results. These studies include two qualitative studies funded by the World Bank: “Assessment of Child Birth and Death Registration in Tajikistan” (Chikovani et al., 2011) and “Improving Statistics for Children’s Births and Deaths” (WB, 2011). Another study carried out by the SSA includes both a qualitative and quantitative assessment, “Results of a survey on infant, child and maternal mortality” (SSA, 2011). These studies provide detailed accounts of the prevailing shortcomings, including the deterioration of reporting coverage of births and deaths. This decline in the quality of the CRS started in the 1990s due to the loss of mechanisms that were in place during the Soviet times due to the onset of the civil war. Key points that can be inferred from the different evaluation studies include:

- Lack of data reconciliation between MoH and CRS. CRS fails to capture a large share of deaths during early neonatal and neonatal periods (SSA, 2011). MoH captures a larger share of these early deaths, but unless this information is shared with CRO, these are not registered. This problem is especially evident in the indicators calculated from this information: early childhood mortality is significantly underestimated, life expectancy is overestimated, and crude death rates are implausibly low.

- For these reasons, the country relies on information from national surveys which are more expensive, labour intensive, untimely, and usually dependent on donor timing and funding. An important part of the solution to this problem is to ensure that data, especially on early deaths, are reconciled between MoH and CRS at local levels.

- Obstacles for individuals to register births and deaths include payment requirements which are modest but could deter very poor families from registering. Further deterrents include the documentation formalities required, especially the lack of marriage certificates, lack of knowledge of how/where to register, and the requirement to report the event in the district of residence regardless of where the event occurred.
• Disincentives for reporting (e.g. punishment for reporting early infant deaths or maternal deaths) discouraged honest reporting.

Overall, Tajikistan can be said to have a functioning CRS, and one which arguably worked well in terms of completeness of reporting of births and deaths during the Soviet period. The CRS system is paper based with minor use of computerized office applications. A major concern of CRS management is related to registry books, which are old and make it difficult to access information easily.

3.4. Information Systems in the Healthcare sector of Tajikistan

HIS in Tajikistan largely continues to be influenced with its Soviet legacy of a centrally managed economy apparatus with few changes introduced during the last decade of independence. An assessment provided in 2009 by applying Health Metrics Network (HMN) framework (Table 3.3) shows the most recent status of HIS resources of Tajikistan.

<table>
<thead>
<tr>
<th>Summary of Result</th>
<th>Max</th>
<th>Score</th>
<th>%</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy and Planning</td>
<td>15</td>
<td>9,2</td>
<td>62%</td>
<td>Adequate</td>
</tr>
<tr>
<td>HIS institutions, human and financial resources</td>
<td>39</td>
<td>17,3</td>
<td>44%</td>
<td>Present but not adequate</td>
</tr>
<tr>
<td>HIS infrastructures</td>
<td>15</td>
<td>5,4</td>
<td>36%</td>
<td>Present but not adequate</td>
</tr>
<tr>
<td>Overall results</td>
<td>69</td>
<td>32</td>
<td>46%</td>
<td>Present but not adequate</td>
</tr>
</tbody>
</table>

There have been many global and local attempts to strengthen HMIS of Tajikistan. In 2001, the MoH RCSMI (Republican Centre for Statistics and Medical Information) developed an in-house application for data collection, called MedStat which was built on Microsoft FoxPro with dBase tables on the backend. MedStat is an offline application with import/export functionalities and limited aggregation functions. It lacks ad-hoc analysis and reporting functionalities. As of 2010, MedStat was implemented in almost 90% of the districts. Despite being nationally implemented and sustained, MedStat did not effectively respond to the present needs of health managers. It was designed to be a reporting tool, not an analytical

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2 It has been reported that in some hospitals infant mortality data are manipulated and adjusted to show better performance
tool. MedStat represents an electronic copy of the paper based system, which is also in use. Districts and provinces are submitting both the electronic and paper versions of reports.

Tojikinfo is a website, developed in three languages by the State Statistical Committee under the President of Tajikistan with the support of UNICEF, to disseminate information products available in Tajikistan. Tojikinfo is based on DevInfo software, is a powerful database system which monitors progress towards the Millennium Development Goals. It generates tables, graphs and maps for reports and presentations. DevInfo has been developed in cooperation with the UN system and has been adapted from UNICEF ChildInfo technology. The database maintains indicators by time periods and geographic areas to monitor commitments towards sustained human development.

The Community based health project, financed through a World Bank loan amongst other activities is developing an Electronic Patient Record (EPR) system, called Form 66, implemented from 2008 onwards. Form 66 is also based on Microsoft FoxPro and is a standalone application, which is a register for all records related to patient discharge from hospitals. Its development and implementation started in line with co-payment and GBP. According to the MoH officials, it has been completely installed and made functional in all districts of Khatlon and Sogd provinces. This system has a module for co-payment mechanism – insurance schema where patients also contribute to health care services.

The Health System Reform Project (HSRP) is directly linked to health system reform launched in 2005. HSRP developed a National HMIS Development Plan for 2006 – 2010. Despite these efforts, poor planning and coordination led to fragmentation of these projects with little integration between them. In the fall of 2007, through HSRP, a technical team from the University of Oslo introduced in five pilot districts the DHIS2, a free and open source computerized health care data warehouse and analytical tool. The DHIS2 has been developed on a global architecture and subsequently has been adapted in many different countries in Africa and Asia (Braa and Sahay, 2012). The DHIS2 has been developed by a global community of developers coordinated through a core team in Norway and supported by Norwegian government funds. This system has been consciously designed with a high degree of both standardization and flexibility in mind to enable both global development and local customization. Simultaneously, there have been attempts to develop local applications (such as MedStat2) that can at some level “speak” to the global DHIS2, in contrast to the existing hardcoded system - MedStat. While the MedStat can be described to be technologically
obsolete and institutionally inadequate to meet the current needs (say of monitoring national progress on the Millennium Development Goals (MDG) which is a stated national priority), the system cannot be scrapped as it is deeply embedded in the political and institutional structures of the national health system.

While on the one hand, there were forces favouring the continued life of the MedStat, the forces of reform positioned DHIS2 as the system to tackle the current inadequacies of MedStat and the overall HMIS in general. The forces of global legitimacy and funding may have contributed to DHIS2 being welcomed by the stakeholders and a pilot project was run during 2008 in eight remote districts in the country at the district level. Prior to this pilot run, an intensive process of customization of the global DHIS2 to the local needs of the country was carried out by a team of Oslo researchers. Understanding the dynamics experienced during the customization process and how they were addressed (or not) is an important focus of my research.

3.5. India and its Healthcare System

The Republic of India is situated in South-Asia with the seventh largest territory and is the second most populous country in the world with a population of more than 1.21 billion people (NFHS-3, 2011). 50% of its population are below the age of 25 and more than 65% are below the age of 35; and only 25% of population are urban habitants. India’s economy is ranked as the tenth largest in the world.

Despite profound economic achievements and significant progress in improving various healthcare indicators such as life expectancy at birth, reducing mortality due to malaria, and reducing infant and material mortality (Kapil and Choudhury, 2005), the overall health status of the Indian population has remained unsatisfactory. One reason for this is the disparity between the top 18% (socio-economically high) and the bottom 36% (socio-economically low) households. There is a high concentration of public curative and hospital services in urban areas, whereas 75% of the population lives in rural areas. In rural areas, public healthcare is mostly limited to preventive and promotive care such as family planning and immunization. Private healthcare dominates in curative care and hospital services both in the cities and remote areas, but are not always being able to provide quality services. Further, a very large proportion of private providers are not qualified to provide modern health care because they are either trained in other systems of medicine (traditional Indian systems like
Ayurveda, Unani, Siddha, and Homoeopathy) or worse, do not have any training (Gangolli et al., 2005).

In 2005 the Government of India launched the National Rural Health Mission (NRHM) with the goal to provide effective healthcare to rural people with a focus on 18 states which have poor public health indicators and/or weak infrastructure (Kapil and Choudhury, 2005). NRHM have set 14 key priority areas for improvements, with the aim to establish fully functional, community owned, decentralized health delivery systems. The NRHM is expected to bring improvements in the health system by making architectural changes in the entire health system. NRHM has focused on developing a fully functional health system at all levels from the village to district by promoting decentralization and at the same time fostering accountability. HMIS and Hospital information systems improvements are thus set as priority areas for monitoring and evaluation of progress of reform objectives.

The district hospital in the Shimla city of Himachal Pradesh State of India, where the design, development and implementation of new HospMIS is taking place, is my primary research site. The population of Himachal Pradesh is about 7 million and it has relatively good health indicators compared to other states of India. With larger success in aggregated data reporting and use in decision making, the State NRHM, decided to improve the hospital management system. With decentralization and ongoing increase in hospital autonomy, there was a strong need for a well-functioning management system in public hospitals. I was part of the team (HISP India) engaged the design and development of such a system.

3.6. Challenges and gaps in the Health Information System of Tajikistan

I have provided a historical overview of the socio-economic, cultural and political aspects of independent Tajikistan, including its healthcare system. Also a brief overview of the Indian healthcare system and particularly hospital management issues in Himachal Pradesh State was presented. This provides the background for the empirical settings of this thesis, including how the HMIS initiatives are situated within the wider context of healthcare reforms in the countries. For example, in developing and implementing HospMIS in India, many changes were iteratively introduced into the new system along the line of discovering new relations and factors such as willingness of medical doctors to use ICTs in their daily work. Furthermore, a broad description of the healthcare delivery system and HMIS is useful to understand existing work practices, infrastructures and challenges of the HMIS implementation in the developing country context.
Many of the challenges to HMIS and HospMIS are related to the institutional changes introduced by the administrative, financing and healthcare delivery changes in Tajikistan. While many areas of healthcare have been reformed, HMIS to a large extent remains in its initial paper-based form and does not fulfill current needs. A number of attempts to reform the HMIS have had little success due to influences arising from existing formal and informal institutional arrangements. For example, underreporting is an informal practice directly affecting the quality of underlying data, which possibly leads to inappropriate decisions.

Aggregated data recorded in reporting forms, each containing from a few to dozens of tables with varying columns and lines, sometimes consisting of several pages. Most of the forms were designed based on a facility profile format, containing diverse data ranging from disease profiles to staffing, hospital beds and equipment. The mish-mash of data makes it difficult to be used for decision making. While several ICT applications have been developed, no attempt has been made to link them through standardized interfaces avoiding repetitive data capturing and other redundancies. Lack of coordinated and standardized data reconciliation among various HMIS stakeholders has also affected timeliness and quality of data.

As the healthcare system has become increasingly aid dependent, donor organizations have contributed to the fragmentation of data reporting by supporting specific programmes like TB and HIV/AIDS in the absence of a health systems framework. This fragmentation is very clearly evident in the HMIS. In an effort to standardize, donor organizations, within global frameworks, are continuously providing technical and financial support for strengthening HIS, building proposals for global guidelines, building technical capacity, developing infrastructure, and the injection of technical expertise. The technical assistance originating from these sources need to be aligned and developed within local frameworks, including local language, human resources capacity and infrastructure in order to make the evolving HIIs sustainable and scalable.

In summary, a lack of coherence between the information collected and information needed; limited use of the generated information; reliability issues of the collected information; weak standards in data definitions; poor capacity and infrastructures have all grossly contributed to suboptimal functioning of Tajikistan’s HMIS. In India, HospMIS was an attempt to build a fully functional hospital management system based on open source medical record system, a complex task in a primary paper-based environment. The potential use of this system in other hospitals in the state and potentially in other states raised the demand for using standards and
making the system generic. In Tajikistan, the aim too was to learn from global experiences and standards, which come with their own challenges and opportunities. This thesis thus attempts to develop a perspective to better understand the interplay of globally developed standards as how they are introduced into the local settings.
Chapter 4

4. Empirical research approach

After providing an introduction to the thesis in Chapter 1, in Chapter 2, I have provided a discussion on the theoretical underpinnings. Chapter 3 has provided details on the empirical setting by describing the contexts of Tajikistan and India, with a focus on the health sector and the supporting health information systems, and hospital information system in case of India. In this chapter 4, I further go into the empirical details by discussing the research design, data collection and analysis methods.

This chapter is organized as follows: Section 4.1 provides the philosophical basis for the research approach, from which the research design and empirical methods deployed in this research are elaborated upon in section 4.2. Section 4.3 briefly describes data sources and finally in section 4.4, the data collection and analysis methods are presented.

4.1. General approach to empirical work

The choice of research approach largely depends on philosophical assumptions around theory, the problem context and the research problem at hand (Oates, 2006). In information systems research, three broad research approaches have been identified: namely positivist, interpretive and critical (Orlikowski and Baroudi, 1991; Klein and Myers, 1999).

The positivist approach, having its roots in natural sciences, focuses on establishing formal hypothesis, quantifiable measures of variables, hypotheses testing and making statistical generalizations from a sample where the phenomenon is studied to increase predictive understanding (Orlikowski and Baroudi, 1991:5). A positivist approach assumes that the objective physical and social worlds exist independent of the researcher, and its nature can be apprehended, characterized and measured (Johari, 2009:25). Thus methodological assumptions of positivism rest on reductionism, repeatability and refutation (Oates, 2006). This provides the basis for the ontological assumptions of the researcher being detached from the objects of research to avoid “biases” (Orlikowski and Baroudi, 1991; Levin, 1994). Epistemologically, the assumption that objectively collected data represents the real world, and theory is applied in an attempt to increase the predictive value rather than developing a descriptive understanding of the phenomenon (Walsham, 1995b). Generally speaking, in a
positivist belief, knowledge is created by generalization of different samplings or experiments that produce unique results, which then could be applied to other settings and larger populations (Oates, 2006).

Contrary to the positivist worldview, an interpretivist approach assumes that reality is socially constructed. An interpretive researcher seeks to develop an understanding of the phenomenon within a particular contextual situation. The researcher is seen as part of and influencing the phenomenon of study, which is examined in its natural settings and from the perspective of the participants (Orlikowski and Baroudi, 1991:5). Interpretive approach rests on the philosophical assumptions that reality can only be understood through social constructions, such as language, consciousness, shared meanings, documents, tools, and other artefacts (Walsham, 1993; Klein and Myers, 1999; Myers and Avison, 2002), emphasizing multiple subjective realities, where the focus is on understanding how inter-subjective meanings are constructed (Oates, 2006). Subjective reality emphasizes that the same situation might be interpreted differently depending on who provides the account of it (Walsham, 1993), based on their backgrounds including culture, education and experiences. In other words, interpretive research does not predefine dependent and independent variables, but emphasizes the complexity of human sense-making as the situation emerges (Kaplan and Maxwell, 1994).

Interpretive research has been used and gaining increased popularity in contemporary information systems research, including studies of health information systems (Walsham, 1993). Walsham (2006) provides a detailed account of conducting interpretive research starting from the selection and justification of a research site and style of involvement, maintaining access to the site, working in multiple sites, data collection, choice of theory, data analysis, and formulating a research contribution. Klein and Myers (1999) likewise have proposed seven principles to guide interpretive information systems research. They start with the core principle of the hermeneutic circle which implies that understanding of a complex whole is made up of a preconception of its parts and their interrelations. Having the hermeneutic circle as a meta-principle, they list other important principles of contextualization, subject-researcher interactions, abstraction and generalization, dialogic reasoning, multiple interpretations and sensitivity to possible biases. These principles are not only useful for doing interpretive research, but also for evaluation of credibility of the results. Walsham (1995) has defined four mechanisms for knowledge generation (generalization)
from interpretive research, which are giving “specific implications”; “rich insights”; “concept development” and “theory generation”, which can be applied to other settings.

Critical research builds on the epistemological assumption that social reality is shaped by people:

“Critical research seeks to be emancipatory in that it aims to help eliminate the causes of unwarranted alienation and domination and thereby enhance the opportunities for realizing human potential (Alvesson and Willmott 1992; Hirschheim and Klein 1994). To make this possible, critical theorists assume that people can consciously act to change their social and economic conditions. They do, however, recognize that human ability to improve their conditions is constrained by various forms of social, cultural, and political domination as well as natural laws and resource limitations” (Klein and Myers, 1999: 69).

While the critical approach is methodologically close to the interpretive approach, they differ in the way that the critical approach tends to focus on macro-social studies, emphasizing the role of power, opposition, conflicts and contradictions in societal life, and how objective aspects also influence researcher perceptions. Examples of critical research can be found in Foster (1992), Ngwenyama (1991), Ngwenyama and Lee (1997). Ngwenyama and Lee (1997) provided a detailed account of the critical approach compared to positivist and interpretivist approaches by elaborating on the concept of ‘emancipation’ as a distinguishing feature from the other two. They claim that the positivist approach and for the most cases interpretivist do not count for validity or rightness of what has been communicated, while in critical approach the listener does not accept the speaker’s utterance at face value, but questions its validity claims and sees that it is incomplete, false, unclear, or inappropriate.

Each of the three research approaches presented here are used in the mainstream information systems research, with their relative strengths and weaknesses. Therefore the choice of a research method always bears both a gain and a loss (Schulze, 2003), and these need to be explicitly understood. My choice of research approach is based on the following assumptions. Firstly, the research questions I address in this study do not involve the search for a single generalized “truth”, as advocated for from a positivist position. Secondly, as presented in the introduction, information systems implementation tends to be context sensitive (Avergou and Walsham, 2000; Walsham, Symons & Waema, 1988), there are commonalities and difference between different contexts (AbouZahr and Boerma, 2005; Foltz, 1993), and implementations
are also dependent on cultural cognitive aspects of social life. With the assumption that reality is socially constructed, it is important to understand subjective reasons and meanings that lie behind such social action in order to understand a phenomenon within the context. The interpretive approach is well suited to this philosophical assumption, where knowledge and meanings are acts of interpretation and there is no objective knowledge and meaning without human reasoning (Gephart, 1999). Access to reality is only possible through social constructions such as language and shared meanings (Myers, 2009). In order to gain such knowledge and understanding, the researcher acts as a participating observer (Henning, Van Rensburg and Smit, 2004), and engages in activities to help discern the meaning from actions as they are expressed in context.

The interpretivist approach extends to the research context and helps develop subjective understanding of the phenomenon as a socio-technical process. This involves a complex correlation of technology and various actors with their assumptions, beliefs and practices. In my case, actors included global partners to national (central ministry) and local (in the district and peripheral facilities) entities, each with their respective interests and interpretations of reality around the health information system and the underlying standards – the objects of my study. My approach focused on understanding these complexities of human sense making and how they change or not over time (Kaplan and Maxwell, 1994).

4.2. Research design

After discussing the philosophical foundations of this work, which is based on an interpretivist approach, I now focus on describing the selected empirical research methods. The empirical approach combines case study and action research, each of which are discussed in more detail in respective subsections of this chapter. The choice of these methods is based on my perspective of information systems implementation in organizations not being static but evolving and dynamic in nature: making both the process as well as the outcome important: Following the line of Fujimura (1996), where she achieves a “creative balance” between several methods and styles with an argument that “The production of knowledge is a multidimensional process whose traces can be followed through multiple cultures, institutions, actors, objects, and practices” (Fujimura, 1996:17). The primary research site for this study is the Ministry of Health, Tajikistan, spanning its national, regional and district levels units. Although not in my original plan, I had the opportunity to participate briefly in an ongoing initiative of HISP in India. This opportunity came by virtue of me being part of
the global HISP network, and that I was supervised by a professor who was also responsible for HISP India. This opportunity was in the form of the design and development of a patient based district hospital system for a facility in the northern state of Himachal Pradesh. This effort helped me to gain some understanding related to the issue of standards in hospital information systems, and provided the empirical basis to write one paper relating to standards in hospital systems that is included in this thesis.

4.2.1. Case studies

The empirical work consists of two case studies, both related to the study of standardization processes of health information systems. The first, and the primary one (Case 1), was in Tajikistan and conducted during 2007-2011 in the Republican Centre for Statistics and Medical Information (RCSMI) of the MoH. The second case (Case 2) study (May-July and September – November 2010) was in a public hospital in Himachal Pradesh, a state in northern India. In both cases, global open source solutions (DHIS2 and OpenMRS respectively), were under processes of local adaptation. In Case 1, I was part of a global team of developers and local implementers, whereas in case 2 I was only part of local team of developers and implementers.

In both case studies, efforts were towards understanding the interplay between global standards and their adaptation in local contexts, with a focus on how the institutional context shapes and at the same time are influenced by this interplay around standardization processes. As discussed in chapter 2, my approach for the analysis was socio-technical, paying due attention to associated inter-connected institutional and technological challenges. In Case 1, I did an in-depth analysis of existing data collection procedures, paper based reporting forms, and electronic databases used to store and retrieve the data, and the challenges being experienced by the users. Case 2 which focused on a different domain of hospitals, helped to broaden my knowledge on the typology of standards, how and at what levels they are used, and the nature of local ‘workarounds’ that are required to make these standards practically work. While Case 1 helped me to develop an understanding of healthcare in general and gain an entry point for doing action research in Tajikistan, Case 2 helped me to understand processes of negotiations between global teams of OpenMRS designers, the local HISP India team of developers and implementers, the hospital staff, and the various artefacts and standards in contention. These included the software, standards like ICD-10, the chain of procedures and practices in the hospital from the stage of patient enrolment to discharge and
various administrative and clinical processes. This exposure helped me to gain a rich understanding around the complexity and working of a district hospital. Table 4.1 provides a summary of the two case studies, pointing to the scope, period and main topics of the research.

### Table 4.1 Case Studies in thesis

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Period</th>
<th>Scope</th>
<th>Main topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1. The Data to Indicator (mis)match: Experiences from Trying to Strengthen This Link in the Health Information System in Tajikistan</strong></td>
<td>2007-2008</td>
<td>National and subnational (districts)</td>
<td>Data quality, information use, data standards, data aggregation, indicators</td>
</tr>
<tr>
<td><strong>Case 2. Practical Approaches To Designing Standards: The Case of a District Hospital Information System in Northern India</strong></td>
<td>May-July and September – November 2010</td>
<td>Single organization (Hospital)</td>
<td>Standards and their typology, emergence of standards, adaptation of global standards</td>
</tr>
</tbody>
</table>

While both cases involve the global/local interplay of standardization, as table 4.1 shows, they have different scopes, in terms of geographic coverage. This brings various socio-technical aspects into play that are then analysed to find influence they have on the trajectory of global/local standardization processes. For example, in the Case 2 where a single hospital was the recipient, it was much easier to discuss the day to day interventions and action plans due to the geographically availability of actors at all levels, from the hospital manager to the data entry clerk. While doing the first case study (Case 1), I had to travel to various destinations of pilot districts to perform evaluations and obtain feedback. Another directly comparable example is how global and local collaborations are set up. In Case 1, I was part of both the local and global teams of developers and implementers. This relation had many advantages as I served a link between the two, providing me access to understand both perspectives. In the Case 2, it was comparatively challenging to communicate with the global team, where the local team had no strong link with global team and communications were limited to weekly Skype calls, mailing lists, versioning and bug tracking systems.

The analysis of both these case studies has resulted in me developing a deeper understanding of the challenges of standardization within information systems implementation in the
healthcare domain, in two contexts which also helped me to develop implications for developing countries more generally. Knowledge gained through these case studies also helped to carry out my action research interventions, such as related to the design of the database for the HMIS in Tajikistan.

As a researcher, I have been directly involved in the process of data collection and analysis (Creswell, 1998; Klein and Myers, 1999); and through close interaction with other actors, I have also become a “passionate participant” (Guba and Lincoln, 1994, p. 115). Such engagement provided me with the opportunity to gain deep insights into the problem under the study, and develop meaningful interventions that were instrumental to create change, and at the same time study how it came about and its effects (Avison et al., 1999; Avison, Baskerville & Myers, 2001; Miles and Huberman, 1994). This process is discussed next.

4.2.2. Action research

My action research approach can be described as elaborated by Braa and Vidgen (1997):

“In some forms of research, such as action research, the aim is to gain learning and knowledge through making deliberate interventions in order to achieve some desirable change in the organizational setting. Thus, a researcher working in the organizational laboratory is both constrained and enabled by the context while at the same time the researcher has the potential to initiate change (to a greater or lesser extent) in that organizational context” (Braa and Vidgen, 1997:2).

Action research tries to solve practical problems bringing research findings to the practical use and at the same time contribute to the generation of knowledge. Unlike other research methods, where the researcher seeks to primarily study and describe a phenomenon without bringing change, action research is concerned with enabling organizational change and simultaneously studying the process (Baskerville and Myers, 2004). In this way, the researcher brings his/her knowledge and theories into action along with situated practical knowledge of practitioners, while assuming reality as situated and socially constructed (Baskerville, 1999). The process involves continuously evaluating the intervention and associated interpretations allowing for a better understanding of the situation from different points of view (Miles and Huberman, 1994).

Baskerville and Myers (2004) have divided action research into two main stages: diagnosis and therapeutic. Cardno (2003:13) describes action research as “a spiral of steps, each of
which is composed of a circle of planning, action, and fact-finding about the result of the action”, thus one cycle leads to the next. This is translated into the following four phases of the action research process: (1) issue identification, (2) investigation and analysis, (3) planning and action, and (4) evaluation and reflection. The inter-connected cycles of action is broadly reflected in my experience of piloting DHIS2 in remote districts of Tajikistan, which led to learning about what worked and what did not, feeding into the next phase of national DHIS2 implementation. Since action research involves multiple viewpoints and is emergent in nature, it is often beyond the control of the researcher (Baskerville, 1999), not always following an ideal path, and will often be non-sequential in nature (Bate, 2001). Thus, action research provides a framework of continuous improvement and change, while also enabling the generating and validating of social theory (Baskerville, 1999; Mumford, 2001), which are amenable for continuous improvement (Avison et al., 1999:95).

Figure 4.1 below depicts the two cycles of action research I carried out during the implementation of HMIS in Tajikistan representing a spiral model of Cardno (2003). While reforms in HMIS are ongoing, dividing the process into two action research cycles is based on key issues identified, analyses, actions taken and evaluation of the achievements and output of actions. The output of the first cycle has fed into and was basis for the next cycle of action research, which is also in line with the HMIS implementation project which had at its foundations the learning from the pilot project. The two phases of the action research include:

1. Pilot testing of the DHIS2 application with the aim to address issues of data anomalies and redundancies in the national HMIS. During the piloting of computerized HMIS many shortcomings of the existing system were discovered, a key one being that the existing system is “data driven”, and not “action led”. Piloting also revealed a range of institutional challenges contesting the creation of a sustainable and actionable HMIS.

2. The second phase of action research was mainly driven by the outputs from the first intervention, with clear implications for higher level structural changes spanning all levels of and some beyond healthcare, including technical capacity and organizational arrangements. A key reform agenda of the government was to strengthen the health system, with a key focus on expanding the analytical functionalities of the supporting HMIS and making it more relevant to the new institutional changes in process since Tajikistan’s independence. The first and foremost important task was to standardize indicator definitions and streamline them with the national health strategy. Taking this as the point of departure, the revision of data
elements and corresponding recording and reporting forms were targeted. The focus was on building consensus among stakeholders, and towards the development of the implementation plan.

Figure 4.1 Two cycles of action research in Tajikistan HMIS

In 2012, most of the decisions were made with regards to the implementation, such as details of the roll-out plan was agreed with stakeholders; ordering the required networking and computing equipment, and preparing of training and capacity building materials. The stage is thus set for the nationwide roll-out to take place starting 2013. Slow progress and administrative barriers have delayed the timely completion of the second cycle of my action research due to my PhD term coming to an end. The implementation is complex, and such delays are inevitable, for example bringing the CRO into the HMIS arena, which comes under the Ministry of Justice, is a highly complex process on its own.
**4.3. Data sources**

Data collection involved both primary and secondary sources for both the Tajikistan and India contexts. Primary data sources included interviews with key stakeholders of the HMIS and hospital in Himachal Pradesh state of India; active participation in working group meetings in the hospital; participant observations in capacity building and training, and direct actions performed such as the design and development of the database and modules for HMIS and hospital systems. In the case of India, sometimes translation and interpretations were required, when meetings or discussions spontaneously shifted between English and Hindi languages. Other colleagues from HISP India generously helped me to overcome this language barrier. Secondary data sources involved mainly the study of government orders and publications; technical documentation and analysis of paper based and electronic health data. Valuable insights were gained from studying consultancy reports such as the “Tajikistan Health System Review” from *European Observatory on Health Systems and Policies*, which provided a detailed study of the current situation around HMIS of Tajikistan (HMN, 2009, Khojamurodov and Rechel, 2010). For example, these authors divided Tajikistan’s HMIS into three distinct time periods: Soviet period (up to 1991), post-Soviet transition period (1992 - 2005), and finally the reform period (2006 - ongoing). Each of these periods involved significant socio-political and economic changes, including improvements in information infrastructure at national and ministerial levels. Secondary data was useful for me to triangulate information that I gathered in interviews, to understand background information on historical events and who the key players were in the HMIS and hospital information systems reform processes. Also secondary data was used in the preparation of questionnaires used in interviews, for example the knowledge of electricity shortages affecting HMIS performance in Tajikistan led to inclusion of questions regarding electricity supply.

**4.4. Data collection and analysis**

Data collection methods were primarily qualitative, and involved “a variety of theories, methods, observers, and empirical materials to produce a more accurate, comprehensive and objective representation of the object of study” (Silverman, 2006:201). Richardson and Saint-Pierre (2005) termed the use of multiple sources of data as *crystallization*, allowing the researcher to carry out multi-faceted analysis from a variety of perspectives. “Crystallization provides us with a deepened, complex, thoroughly partial, understanding of the topic. Paradoxically, we know more and doubt what we know. Ingeniously, we know there is always
more to know” (Richardson, 2000:934). For example, findings from the case study from India were useful in comparing with the Tajikistan case in many aspects, such as the institutional structure driving reforms. For example, in the India case, the medical doctors were interested in the computerized system, where some sort of assistance to them was directly available from the system, like electronic X-Ray imaging. They always pointed to high load of patient per day as a reason for not being able to use the system for data capturing. In case of Tajikistan, in the districts and areas where Pay for Performance (P4P) mechanism was being piloted, I observed high quality and accurate data collection as compared to other districts that did not practice P4P. This was due to personal gains, in terms of the salary increment that the medical doctors received from collecting and recording data at the same time contributing to provision of better healthcare services. Analysing both cases, I came to an understanding that institutional changes can enable or create barriers to information systems implementation and sustainability, no matter how good the underlying system is. These analyses are based on qualitative data, collected through observations which demonstrate how meanings residing in social practices are mediated mainly through language and action (Dey, 1993). The concept of incentives from institutional theory was used to theoretically study these empirical findings where some sort of driving mechanism enables or disables actor’s actions.

Throughout the course of my empirical intervention, I was actively involved in various events, including participation in various meetings, formal and informal discussions, prototyping of a new system, site visits and observations, and in conducting capacity building programs both in India and Tajikistan. In so doing, I gained a broader in-context and practical understanding of the phenomenon as situated within the real context. As Sayer (1993) notes, knowledge does not develop in vacuum, but is always embedded within social practices, to fully understand the former one must know the latter. In the process of doing action research, I also collected various forms of qualitative data using different techniques. Through continuous evaluation of the interventions and the associated interpretations of myself and my research and MoH colleagues, I sharpened my understanding of the situation from different points of view (Miles and Huberman, 1994), which helped to orient me on how to improve the focus of my further interventions.

HMIS implementation is a complex socio-technical process, requiring the complex interaction of many components, including humans, technology and politics. Thus the assessment of a project implementation, be it HMIS at national level or the hospital
information system in a single hospital boundary is better understood by observing how participants contribute and make progress with respect to various socio-technical issues.

My broader focus was to understand the issues of standardization, and specifically different standard types and how they evolved over time. I wanted to understand these issues from the perspective of users and within the context as perceived and described by different individuals at various capacities. I tried to develop a clear understanding of how the processes of “localization” and “contextualization” of standards take place and how these contribute back to “generification” of the same at the global level. Following the interpretive approach, my position as a researcher was to build a “common understanding” with participants without filtering and applying judgement to users’ interpretations being right or wrong, and constructing a picture of the context in the complexity of the daily routines of the people involved.

As is the case in most interpretive research, data analysis even started during the process of data collection helping to refine the next cycle of the data collection (Miles and Huberman, 1994) or intervention. I tried to understand historical events and processes, such as the Soviet legacy; both in material and institutionalized forms, physically existing and in the minds of actors, and how they shaped current HMIS data flows and standards. I analysed the differences between India and Tajikistan for major political changes in the recent past and associated major institutional changes. This required an understanding of different perspectives to these historical events. For instance, I tried to understand how formal rules and norms around the HMIS and corresponding standards were established and institutionalized. For example, the mandatory national indicators, their periodicities and data sources, and the purposes they were used for. India’s political stability in the past decades has brought fruitful changes in almost all areas of life, making India one of the biggest economies of the world. On the other hand, Tajikistan has suffered from instability and civil war affecting rapid development, while both countries shifted from a centrally managed economy to more liberal and democratic structures starting 1991. This had actually many influences starting from individual to organizations and the national. For example, in India a large portion of hospital services are run by the private sector, while in Tajikistan this process is just taking place and related institutional changes are coming to the fore.

Being a person from outside of the health sector by profession, some of the issues were difficult for me to understand, and I sought help from the staff to develop deeper insights into
the issues. Special attention was given to the understanding of the institutional context, norms and practices embedded into information infrastructure at different time periods from users’ perspective. This helped me in gaining knowledge of how these institutional arrangements shape current actions and meanings that users give to HMIS in general.

Interviews conducted in Tajikistan and India, were of two types: semi-structured and structured. Structured interviews helped me to assess the infrastructure in the district health and CRO offices, including the availability of electricity, Internet connectivity, computing hardware, personnel and computer literacy, and the impressions of the respondents on the adequacy of the same. Structured interviews were conducted also during the situation analysis phase, sometimes through telephone calls and often involving random visits to some districts. Telephone interviews were recorded with the aid of a pre-printed questionnaire, where possible answers were provided to the respondents and their responses marked on the sheet. There were also some open-ended questions. Informants were notified that their responses were being written down, and that no voice recording was done. The interviews conducted in Tajikistan and India are summarized in the table below, and the questionnaire used is inserted in Annexure 6.

**Table 4.2 List of interviews conducted**

<table>
<thead>
<tr>
<th>Roles</th>
<th>Level</th>
<th>Face to face interviews (semi-structured)</th>
<th>Telephone interviews (structured)</th>
<th>Duration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tajikistan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District Health Management Unit (DHMU) and hospital and PHC Managers</td>
<td>District</td>
<td>12</td>
<td>0</td>
<td>1.5 – 2 (0.10 - 0.15 phone interviews)</td>
</tr>
<tr>
<td>Health statistics (Manager and Staff)</td>
<td>District</td>
<td>14</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Province</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>National</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>State statistics Agency</td>
<td>District</td>
<td>2</td>
<td>0</td>
<td>~1.5 (0.10 - 0.15 phone interviews)</td>
</tr>
<tr>
<td></td>
<td>Province</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>National</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Civil Registry Officer</td>
<td>District</td>
<td>5</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>
Semi-structured interviews were also performed during formal and informal meetings with staff from various levels in the CRO, SSA and MoH offices (see Table 4.2 above). A series of formal interviews were conducted during pilot phase involving visits to the following provinces:

- Sogd (10 districts were visited)
- Khatlon provinces (5 districts) during the middle of 2010 and the other 2 during fall 2011. In 3 of the districts visited DHIS2 was piloted

In each district visited, I tried to meet with the CRO, SSA and health managers and health statisticians jointly. Sometimes due to time and logistical constraints, this was not possible. These interviews helped me to understand how these independent units collaborated on health related information, for example, how data flows were taking place (or not) from one organization to another.

In India, I interviewed hospital staff and senior managers, other software developers from HISP India (see Table 4.2 above) related to the development of modules for the hospital information system, where I thought their input would be most valued. My approach to semi-structured interviews was to initiate discussions around processes of data generation, collection, and aggregation and to see how local managers and statisticians actually carry out their work, and deal with challenges. Participants were encouraged to raise their own issues and questions related to the subject of our discussion, some of which I had not even thought of. I recorded the responses in my diary, which often represented a “wish list” of the respondents, with respect to the information systems strengthening they required.

The core principle in my data analysis was inductive reasoning that is to construct or evaluate general topics (themes), which were derived from specific facts gathered during data
collection. While the collected data represented the interpretations of participants, during the analysis I filtered data through my understanding of socio-technical dimensions of the underlying context. Through action research, I participated in the design, development and implementation of the new HMIS in Tajikistan and the hospital information systems in India with a primary focus on the topic of standards. This helped me to gain more knowledge of the existing systems and their relations to the institutional context, as it involved closely working with the HMIS and hospital staff at various levels. In the course of prototyping of the DHIS2 system for the HMIS in Tajikistan, I had the opportunity to also discuss with the staff many aspects of the healthcare system in general that led to finding useful information closely linked to their experiences.

Data analysis was performed by interpreting the data and summarizing them as compact and accurate representations, resulting in the identification of key themes. This guided my design strategy and generated new perspectives and questions for the consequent data collection. For example, finding that data elements in the existing HMIS were excessive and many had zero or null values led to the examination of indicator to data element linkages. This guided me to use “indicator to data element linkages” as a perspective to revise dataset standards. The themes then were subject to further discussions, involving many other activities including the reading of related literature, direct interventions, formal and informal discussions with my research supervisors, faculty and colleagues, presentations in international conferences and writing of research papers. Feedback received from the larger research community helped me to revisit and refine my approach in data analysis and expand the scope of my interventions. Analysis of empirical data contributed to the development of research papers dealing with the standardization process in HMIS implementation.

Summarising this chapter, the research design approach adopted in this thesis helped in developing an in depth understanding of the IS implementation process employing various data collection methods forming “thick descriptions”. This provided me an access to subtleties of changing and multiple interpretations (Walsham, 1995) to study the phenomenon at its real context. Exploring the nature of dynamics of global/local interplay of standards and standardisation in information systems implementation through my active participation and interpretations of various perspectives of actors involved, a number of significant factors were identified, analysed and discussed.
In the next two chapters, chapter 5 and 6, I provide more detailed accounts of the research output.
Chapter 5

5. A summary of empirical Findings

This chapter summarizes the empirical findings from the five research publications included in this thesis. The papers are presented in a chronological order, indicating also the nature of my research progress. The first two papers (one case study from Tajikistan and other from the Himachal Pradesh) reflect the interpretive case study approach that I adopted which served as the entry point for conducting the action research, related to the subject of standards and standardization process of the HMIS implementation in Tajikistan.

In section 5.1, the summary of each paper is presented describing the specific research questions addressed, which broadly relate to different facets of the process of standardization, and the nature of their global/local interplays. In section 5.2, a synthesis of the findings from the individual papers is provided. This synthesis helps to deliver a more holistic understanding of the challenges and approaches related to the role of standards and the dynamics around standardization of HMIS. These are related to the overall research questions addressed in the thesis, and also provide the foundation for discussing the contributions and implications (chapter 6) arising from this research.

5.1. Summary of individual papers

Paper I: The Data to Indicator (mis)match: Experiences from trying to strengthen this link in the Health Information System in Tajikistan

Reference


Summary
This paper addressed issues of data quality in the existing HMIS of Tajikistan, and the challenges related to balancing between national (or local) standards (such as related to data elements and indicators) and global standards like MDGs. A key argument made in this paper is that Tajikistan and other nations, who are signatories to the MDGs need to improve data quality if they are going to meet the promised goals. The starting point for the argument is that regardless of the fact that the Tajikistan HMIS is collecting huge volumes of data, with a rich potential to support the process for monitoring and evaluation at various levels, including of the three MDGs directly related to healthcare, analysis and action is not taking place. The potential for conducting analysis and based on it, taking actions towards health sector improvements remains unrealized. The paper particularly examines how issues of data quality shape this phenomenon of data non-use.

The analysis is based upon empirical material drawn from the existing HMIS of Tajikistan and is used to develop two sets of contributions. First, it empirically identifies discrepancies, anomalies and (mis)matches in data standards of Tajikistan’s HMIS. Second, it suggests a practical approach on how to improve this (mis)match through the rationalization of data elements and strengthening their linkages with indicators.

The study was based on number of interviews, secondary document reviews and analysis of database containing historical routine data. Analysis of this data helped in the identification of various themes with respect to the HMIS, especially related to issues of standardization. A key theme concerned how the existing HMIS was primarily data driven and not action led, implying its primary focus to be on reporting for meeting the needs of the bureaucracy rather than on the analysis and use of information for action. The focus on the collection of aggregate statistics, which at the end of the year was used for the annual compilation of a comprehensive health statistics book, was largely not useful to support timely action taking. Upward reporting lent itself to almost no feedback aimed at informing action and also increasing the motivation of staff that only saw their task to collect and transmit upwards huge amounts of data. Extreme fragmentation of information, with multiple parallel and uncoordinated flows inherent with redundancies and duplications was another common theme that was identified through the analysis.

We developed a three-dimensional analytical framework, which was then applied to analyse the legacy data in the database to discover overlaps, duplications and ambiguities that adversely influence data quality. This included the dimensions of:
“completeness”: If all the data needed for indicator calculation are available and of good quality,

“fittingness”: Refers to the presence of such complete data required for indicator generation in the HMIS.

“actionability”: Points back to the indicators, with a focus on their usability. To provide indicators with the property of sufficiency in relation to being able to take action, the indicators should be easy to understand, well presented, and the decision makers should have the capacity and the will to understand and use the indicators.

This three-dimensional framework was based on the normative aim that the HMIS should be clearly focused on strengthening the definition and use of health indicators to operationalize decision making targeted at health service improvements. The collection of data which was not linked to the generation of indicators was arguably not a productive exercise.

The analysis of the legacy database showed that the existing data elements being generated by the HMIS are largely not useful, relevant and actionable with respect to the operationalization and use of indicators. To achieve prescribed MDGs, Tajikistan and other nations, require for their national HMIS to support a more effective monitoring of the progress on specified parameters. This requires the strengthening of the data-indicators match on the three key dimensions identified in the proposed analytical framework.

On applying the tripartite analytical framework, we could identify various missing links in the process of data collection, reporting and use in the HMIS of Tajikistan. For local actors (district level), the entire process was seen as largely symbolic, because they do not receive any direct benefits from their actions; they find limited use of data for local decision making. The primary purpose is thus towards fulfilling imposed requirements and responsibilities for upward reporting. At the national level, the data are used for planning, budget forecasting and measuring performance, although on an annual rather than action needed basis. We found that actors are neither interested in standards, or of standards fulfilling the other side of the tripartite relation. Tensions coming from competing logics of centralized (embedded into existing standards) and decentralized (current trends) management, where local actors are given larger autonomy will trigger changes and reformation of relations and remain unless actor-topic-standard relations are built on the basis of mutual benefit.
Paper II: Practical Approaches to Designing Standards: the Case of a District Hospital Information System in Northern India.

Reference


Summary

This paper analyzed the issues related to the designing of standards within the setting of a district hospital system in the context of Himachal Pradesh, a Northern State in India. The paper described the development of a practical approach to the design and implementation of standards during the course of the evolution of a hospital management information system first in one hospital, and later to be scaled to a total of 20 such district hospitals in the state. It was argued that standards developed and implemented in a top-down manner, seeking universality are doomed to fail, as there are always local particularities that the global standards need to be adjusted to. Standardization is conceptualized as a socio-technical process, influenced by different elements including the interaction of system developers and health workers, the distances between service locations, and the decision making styles of managers.

The conceptualization of standards as socio-technical provided a firm foundation to approach the complex issue of standardizing systems within the context of a district hospital setting. The research approach adopted did not attempt to impose standards from the top, but evolve them through a practice based and participative approach. This approach, arguably, provides a higher potential of acceptance of the standard and enhancing its usefulness. For example, the ICD-10, a global standard maintained by WHO was used as the basis for the generation of subset of ICD-10 codes used in the hospital. The future challenge would be to take these standards into the other hospitals, where undoubtly local practices and traditions will challenge these standards, which may be then seen as being “imposed from the top”. The empirical analysis helped to argue how global standard (such as ICD-10) gets introduced into
the local context, and how this ‘local’ standard becomes ‘global’ for other similar contexts, reflecting a process of scaling.

A three level framework of health information standards comprising of information needs, software and interoperability, formulated and evolved through the HISP research network, based on Carlile’s (2004) framework for managing knowledge across boundaries, was drawn upon to approach this issue of standards. While this framework, originally used in the context of the primary health care domain, was indeed useful to understand standards; the empirical analysis helped contribute to its extension by additionally focusing on issues relating to the process of development, implementation and scaling of standards within a district hospital system.

This case differs from others presented in this thesis in a number of ways. First, the scope of the research and data collection is limited to a single hospital, whereas in other cases, standards are from the national down to the facility level. Secondly, there is no previously deployed computerized hospital information system, which makes the case special in the study of standardization process. This allows us to compare the dynamics of negotiation processes in standard building, where the installed base is computerized or is in a paper format. Third, there are cultural and historical differences in national contexts of the cases from Tajikistan and Himachal Pradesh, which help develop insights into how standardization processes are shaped by the social and historical contexts.

**Paper III: Data Warehouse Approach to Strengthen Actionability of HIS: Experiences from Tajikistan**

**Reference**


**Summary**

This paper builds and adds to the findings of the first paper described in this chapter, including the three dimensional analytical framework, and expands the socio-technical approach to the design and development of a data warehouse for the national HIS in
Tajikistan. In particular, this paper addressed the following research questions: What are socio-technical approaches relevant to the design and development of a data warehouse to support the national HIS in Tajikistan?; and how can the data warehouse based HIS help to develop an action-led HIS for Tajikistan?

Findings revealed that the existing data being collected are products of realities of their times (Soviet era) and they hold institutional arrangements embedded in various formats, whether they are paper based HMIS or their later computerized version. Paper based systems represent the installed base, and can be seen as the point of departure by health workers, when it comes to the discussion on data formats, the transformation of data to indicators and their actionability. Thus the approach taken for the development of the data warehouse was to keep the look and feel of the existing system (pre-existing logic) and wrap it inside the standardized data formats (new computer based logic), creating a transitive and transparent (to end user) shift from one to another competing institutional logic. Furthermore, this shift had to be aligned with the national health strategy, and carried out in the framework of a data warehousing methodology. With the new data analysis logic seeded through the use of business intelligence tools, gradually support could be made available for supporting the transition to a culture of evidence based decision making (shifting from one based on upward reporting).

Actors at different levels of the public healthcare system have varying needs for data collection and use. Their relation to data comes from the nature of their functional duties, for example the medical doctor needs most detailed data about the patient, including information about tests, diagnosis, past medical history; the hospital manager is interested to know more on prevalence of diseases, bed occupancy, etc. These relations, which are social by nature, have to be represented in the computerized system, in a way that every actor maintains at least similar levels of information needs. Recurring patterns of these relations are then embedded into global standards. Local legacy data also inscribes patterns of data non-use; many of the data elements have zero or null values during entire period. While hospital managers’ interest in monitoring disease prevalence is common; which diseases are important to monitor are specific to the particular health manager in his or her local setting. In terms of standards, ‘disease prevalence’ is generic and its instance is the localized representation of this prevalence.
There is high resistance from national and sub-national actors to reduce the number of data elements. Implementing the system in a data warehouse framework, allows the analysis of data values with zeros, for which elements and periods. So, the relation of standards, actors and the context of their use are always balanced in the process of actions and takes place over time. This demonstrates that HMIS standards and standardization processes are socio-technical, where one is relative to other and also to other actors and their respective social settings.

**Paper IV: Challenges in Moving to “Health Information for Action”: an Infrastructural Perspective from a Case Study in Tajikistan**

**Reference**

Murodillo Abdusamadovich Latifov and Sundeep Sahay (2013). Challenges in Moving to "Health Information for Action": an Infrastructural Perspective from a Case Study in Tajikistan, *Information Technology for Development*, in print

**Summary**

Drawing on a longitudinal action research of the design, development and implementation of HIS in Tajikistan, this paper argue that the reason for weak progress towards “actionable data” is due to the rather narrow focus on technology, ignoring the broader issues that influence its uptake and use. Health information systems in developing countries are mainly characterized as being “data led”, with vast amounts of data being routinely collected, but with limited evidence of it being used “for action”. We explored this through an “infrastructure” lens to enable a more holistic perspective to understand how complex socio-technical networks with multiplicity of interests, actors, technologies are in play and which need alignment. A key contribution of this paper is to identify facets of a health information infrastructure (HII), including both the constraints and opportunities in making a transition from a “data led” to an “action led” system.

Initially, the proposed strategy of “flexible standards” (see paper 1) was rejected by MoH officials, preferring a more “top down” approach of HMIS implementation. The strategy adopted then was to implement existing data sets “as is” to make visible to the decision makers the inefficiencies and contradictions in the existing data sets. Bringing resources and
expertise into action from the global HISP community and development partners, contributed to significant progress being made in the revision of indicators and data elements.

A key finding from this research was that existing HMIS was deeply rooted in the organizational and individuals’ daily routines, creating an installed base that influences the trajectory of HIS reforms. Based on empirical data, we codified various aspects of the HMIS into internal and external facets of the HII. Analysis revealed that internal facets of HII could be managed by HIS stakeholders, while external facets were largely beyond their control, creating dependencies on other entities and events, requiring also the adjustment of the HII. Other findings of this research showed that organizational changes that motivated individual health workers and provided them with positive incentives also influenced the actionability of data. Internal facets of the HII can support this positive actionability, and we further need to be able to identify shifts in the external infrastructure, and how these may enable or constrain internal development.

**Paper V: Global standards and Local Applications: Case of Implementing ICD-10 Standard in HMIS of Tajikistan**

**Reference**


**Summary**

The intent of this paper was to contribute to the on-going discussion on the interplay of global and local standardization processes. The specific object of study was the global ICD-10 standard, and the attempts to make it as an integral part of the Tajikistan’s national HMIS.

A key theme identified from the study of empirical data was that reporting forms for the most part were consolidated reports of facility or districts rather than being data for further aggregation and report generation. Many forms had a mix of administrative, financial, human resources and health related data. This format of consolidated data reporting is useful in paper based systems, which reduces repetitive manual calculation of totals and counts; in computerized system this may create unnecessary redundancies or even miscalculations. The findings generally indicated the lack of standardized data sets and their definitions. Overall,
From the very beginning of the national HMIS reform in Tajikistan in 2007, the dilemma of standardization was confronted between two systems: the existing HMIS and the newly proposed data warehouse based on the open source application (DHIS2). The conflict between the systems was set off by the competing institutional logics embedded in these systems, requiring institutional shifts both at the local and national levels. Some of the national health managers insisted on the redesign of the existing system. Numerous meetings and discussions led to the formulation of three distinct approaches towards the redesign of the HMIS. How the gap between the “old” and “new” systems should be addressed was high on the agenda of the working group. The first approach was to adjust the data elements being collected to the national health indicators that needed to be generated from this data. This approach fulfilled the national needs, but variations or additions required by the district health administration were not accounted for. The second approach was to analyse the districts’ needs for analytical data in some selected districts and to apply that to the national data sets. The third approach was to record data at the patient level that is to register every occurrence of confirmed clinical cases, into the database and generate aggregate reports from this data. While the latter approach did not reduce the number of data elements, it provided other advantages like reduced data entry forms, and avoiding unnecessary zero and blank records in the database. ICD-10 was proposed to be used in capturing individual patient recordings as the globally accepted coding standard for classification of diseases. The ICD-10 approach also does not tie up reporting to predefined forms with pre-set data elements, but serves as a kind of free form for data collection marked with ICD-10 codes, age, location, and number of visits. The aggregated values then could be easily computed for reporting from the individual records, based on the defined set of criteria, linking data elements to the corresponding record values. Moreover death records could be easily exchanged with the Civil Registry Offices.

With a networked and central database server, the HMIS application becomes the medium for conducting various negotiations between stakeholders and their regional and sub-regional offices. When new standards were implemented, they become immediately available to all. Each system user and group of users will be interested in gaining more profit from use of the system. This driving mechanism is termed as “incentive seeking”. If user(s) receive positive incentives using the system and newly implemented standards, these standards become
accepted and institutionalized. In the reverse case, such implementations run the danger of becoming obsolete or just remain symbolic.

The third approach – use of ICD-10 for recording data plays an intermediary role between the other two approaches which are respectively implemented “top down” and “bottom up”. The district records every occurrence of a disease in its catchment area, avoiding lengthy forms and reducing the burden of data collection. In doing so, it also balances between global and local data needs through locally situated actions in space and time.

This paper reinforces earlier research findings that implementing global standards into a local context is a complex and challenging task, involving various actors, each coming with their interests and cultural and organizational constraints. Together this socio-technical ensemble – the information infrastructure becomes a carrier of institutional changes applied by global standards and localized into specific contexts through negotiations and incentive seeking of actors.

5.2. Synthesis of empirical findings

The different papers presented above tackle various aspects of standards and standardization processes from both global and local perspectives. They cover issues involved in the HMIS implementation of Tajikistan from the early pilot phase to the planning and implementation of systems. The second paper comes from the context of a single hospital and India. The studies and the findings of the papers add up to provide a picture of issues and approaches towards HMIS standardization coming from local imperatives and global experiences. The last two papers, which are based on the longitudinal analysis of HMIS standardization, clearly demonstrate tensions coming from processes of global standards and how they are being absorbed, adapted and customized to local realities. These two papers demonstrate how the HMIS implementation has incrementally reached a higher level of maturity, where standards and standardization are seen as key to this successful process of change. In the earlier papers presented, we see the emergence and necessity for the revision of national standards, discovering socio-technical problem areas through piloting computerized systems and data warehousing techniques as possible ways to address the challenges.

The evolution of HMIS standards, as seen in the papers represents a complex socio-technical process, where institutions, organizations, individuals and technologies develop and evolve in a mutually agreed and negotiated environment. Global standards, coming from external
sources are not always in-line with local settings, thus triggering change processes. Local adaptations of global standards are always based around negotiations among global/local actors in situated contexts. Best practice of local experiences or findings which are reoccurring in the context and other contexts are drawn as recurring patterns and added to the global repository.

The different empirical findings summarized in the papers above help to illuminate different aspects of standardization in the process of HMIS implementation in Tajikistan, which also can be useful to draw implications for other developing country contexts from. Although the different papers have tackled various perspectives in discussing the implementation of standards ranging from macro and micro levels, they all contribute to highlight the interconnected challenges related to the HMIS standards and their standardization process. Four themes were identified summarizing the findings from these five papers:

1) Overloaded data and lack of standardized definitions and guidelines for collection, storage, transmission and interpretation of data - due to various socio-technical-political circumstances, result in inefficiencies of the HMIS, and serve as an installed base to hold back further improvements;

2) Lack of adequate revisions and agreements on HIS standards historically, resulted in significant gaps between existing formal and informal institutional arrangements and organizational strategic objectives. These gaps were embedded in the paper based HMIS and later to its computerized version. This contributes to make the systems ‘data led’ and useful primarily for annual statistical reporting. There is limited local analysis and decision making based on the data being collected;

3) Weak information infrastructure supporting HMIS: lack of trained and qualified technical specialists at all levels of healthcare; limited use of networking services provided by the national telecommunication operators; and insufficient financial means contributes to reporting on an annual cycle rather than on a monthly basis required for making health systems improvements.; and,

4) There is an urgent need to design institutional changes that rationalizes HMIS use among stakeholders by providing incentives, dissemination of knowledge related to local capacity building, self-management, and decentralization.
Furthermore, empirical analysis at the macro level suggests that there is always a tight link and interdependencies between standards (both: global and local), organizational arrangements and the existing HMIS (installed base), each having their respective influences on the dynamics of the standardization process. At the micro level, these relations are seen as individual or group based actions, and their interrelations with local data needs (standards) and their functional duties are dictated by institutional arrangements and organizational objectives.

Findings from the above described papers have helped me to address the key research aims of this thesis in understanding the nature of the dynamics of interplay in global/local standardization process and the challenges and opportunities that arise from this process.

The first research question, as introduced in chapter 1, was broad in scope and subdivided into three other questions. These questions have helped me to analyse various relations in standardization process, the nature of standards and how actors position themselves in the process and related to particular standards. In the table below, I summarize the key findings, challenges and suggest strategies related to the three research questions.

**Table 5.1 Addressing research questions through findings of five papers**

<table>
<thead>
<tr>
<th>Research question</th>
<th>Findings</th>
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<tr>
<td>What are the nature of dynamics in the interplay between global standards and local adaptations within the context of an in-country implementation of HIS?</td>
<td>Local adaptation of global standard in the context of an in-country implementation of HIS is situated and dependent of many aspects of the context of use, such as social, political, technical and the level of abstraction and flexibility of the said in the global definitions and development of the standards. Dynamics of global/local adaptation of standards are concerned with changes over time, which come in the form of evolution and extension of underlying information infrastructure through implementation of new standards and institutionalization of new practices, which is emphasized by the role of the dynamic feedbacks received in the form of incentives by users from the actions taken. <em>(Papers 2, 3 and 4)</em></td>
</tr>
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interplay, and how can we leverage upon the opportunities while mitigating the adverse effects of these challenges?

country context. A key challenge facing the process of generation and use of indicators in developing countries is that there tends to be a significant indicator-data mismatch implying that either indicators are not or can’t be calculated with the data (not) being routinely collected or the poor quality of the underlying data which makes the generated indicators unreliable. (Papers 1 and 3)

- The challenge of scaling the standards developed in the context of one hospital to other hospitals, where undoubtedly local practices and traditions will challenge these standards, which may be then seen as being “imposed from the top”. The empirical analysis helped to argue how global standard (ICD-10) gets introduced into the local context, and how this ‘local’ standard becomes ‘global’ for other similar contexts, reflecting a process of scaling. (Paper 2)

- The challenges of ‘installed base’ was magnified as the staff did not really distinguish between reporting and recording forms, which reflected an adherence to the underlying paper based rather than the computer based logic in which a smaller set of data could generate a larger set of reporting forms. (Paper 4)

- Managing the interaction between the introduction of global standards and local appropriation. (Paper 5)

- Institutional fragmentation of healthcare stakeholders, where linkages among HIS stakeholders are not supported by direct and standardized data exchange and procedures. (Papers 4 and 5)

**Key opportunities:**

- Flexibility provided by data warehousing applications, which provides look and feel of the old system, while in the background manages data in a standard way. (Paper 3)

- Introduction of new institutional practices and organizational rearrangements at peripheral level, like ‘evidence based
financing’ and ‘pay for performance’ have contributed to the local use of data for action. (Paper 4)

- Advancements in external facets of II, namely communications and electricity grids have opened new horizons for distributed and networked HIS. (Paper 4)

- Use of ICD standard for primary data collection was attractive for CRO. Building CRO application for vital events could be easily accomplished using already existing infrastructure provided by data warehousing application of HIS. (Paper 5)

- Developed standards in one hospital settings serves as reference standards while scaling to other similar hospitals. (Paper 2)

**Key strategies:**

- A holistic approach in design and implementation of HMIS as socio-technical process. II as design and implementation strategy. (Papers 3, 4 and 5)

- Balancing local and global requirements through negotiation process by incentive seeking of actors as driving mechanism. (Papers 4 and 5)

- ‘Top down’, ‘bottom up’ and ‘primary level data capturing’ approaches in standardization of data formats, volume and procedures, or combination of all approaches for the maximum optimization. (Paper 5)

The table above summarizes significant challenges and opportunities arising around the HMIS standardization process. Following this, I will in the next chapter raise the level of abstraction of my analysis to articulate my theoretical and practical contributions arising from this thesis.
6. Contributions and Implications

In this chapter, synthesizing the findings from individual papers presented in Chapter 5, I develop the theoretical and practical contributions related to understanding the process of how global standards and the interplays that emerge while being adapted into local contexts.

The basis for the contributions comes from my theoretically informed analysis, drawing upon concepts from information infrastructure and institutional theories framed within ongoing debates around standards and standardization process in the IS research, with a key focus on HIS in developing countries. This chapter is structured in two main sub sections - the theoretical and practical contributions.

6.1. Theoretical contributions

This section discusses key theoretical contributions arising from my analysis. Previous research has conceptualized the interplay of global and local standards as a process of negotiation and discussion (Rolland and Monteiro, 2002; Besen, 1990; Farrell and Saloner, 1988), involving a hybrid of a technical and institutional issues (Farrell, 1993). While the outcome of such negotiations remains largely unpredictable, there are also simultaneously particularities that influence standardization processes, which both constrain and enable the adoption of standards. These are discussed in the form of theoretical contributions. Three key contributions include:

1. Conceptual framework: Analyzing the relationship between actors, standards and the topic of interest to actors and standards

2. Facets of infrastructure – a perspective to narrow down the different aspects of the standardization process

3. Perspective for understanding the incremental and transparent introduction of technology as supporting institutional arrangement
6.1.1. Conceptual framework: Analyzing the relationship between actors, standards and the content of standards

The conceptual framework is developed on the basis of broader conceptualizations and theoretical assumptions derived from information infrastructure and institutional theories, and informed by my empirical analysis. The proposed framework emphasizes the particularities of the standardization process, while keeping the larger picture of the II development at focus. Through emphasizing the relationship between the actors and the content of standards, the framework tries to equally address both the technical and social significance of standards, and the degree of flexibility required by the II (Hanseth and Monteiro, 1997). This requires understanding the diversity and influences the members have with each other, emphasizing both the standards and also human agency.

Attributes and ‘interests’ (embedded knowledge, reality of context) of heterogeneous members involves varying types of relationships, not only between members at the two ends of the relationship, but also between the similar (see figure 6.1). For instance, different actors may have varying perspectives depending on their respective organizational responsibilities and institutional constraints with regards to the standards and the topic. For example, the developers are mostly interested in the design and technical representations of the standard (relation A in figure 6.1), the health manager (end user) in the content (B), while implementers have a degree of interest at both ends of the relations (C). Similarly, standards should have the ability to talk to other standards and parts of the II in technical terms and to maintain flexibility to address the topics of ‘interest’ in any given contextual setting. Topics provide the content (semantics) to standards, which has global and local implications. This knowledge resides in varying degrees at different ends of the relation. For example, radiologist (end user) deals with small subset of ICD codes related to his duties; standard provides metadata definition (syntax) for handling ICD; and implementer is concerned with both: radiologist needs and metadata for handling ICD for any other use.
Figure 6.1 Tripartite relation of standards, actors and the content of standard’s topics

In HMIS indicators, data elements and ICD are type of semantic standards, which require local adaptation. In Tajikistan, the process of defining standard indicators was relatively straightforward. Group of experts at the ministry level and regional representatives in a short period of time agreed on the format and number of indicators. They used the national health strategy (NHS) as the point of departure and radically reduced the number of indicators. But the revision of data elements did not yield similar success to the indicator revision process. The reason for this, arguably, was the heterogeneity of the context (types of facilities - hospitals, clinics, PHCs), the installed base consisting of the formal and informal institutional constrains guiding the actors and the standardization process. Actors at various healthcare levels, representing heterogeneous health facilities could not agree on the formats and what data to collect. At first glance, following the logic of indicator revision, it seemed an easy task requiring an identification of what data elements are needed for calculating the given set of indicators. But this assumption did not hold, as the process was confronted by varying locally situated position of actors, who had other priorities than that of just meeting the requirements of the indicator calculations. The complex relation of actors involved a prolonged revision of forms without any consent and agreement of what is coming next. At first, it looked like the indicators and data elements were similar from a technological point of view, but experience shows that the degree of the relation with the context (topic) dictates what is needed at periphery, which is not the same as what is needed at national level.

There are also cases when one member of the relation is muted or becomes passive (A from figure 6.2), if the standard is purely technical, and the topic is marginal or (B) if the topic is purely organizational then the standard is muted. For example, for the DHIS to function it
does not matter how many indicators are adapted as the national standard, and the primary concern is the metadata, representing globally accepted standards. Multiplicity of viewpoints and attributes associated with varying socio-technical understandings of context and the diversity of human and/or organizational actors requires a context-sensitive and socially informed working solution (Rolland and Monteiro, 2002).

**Figure 6.2 Muted relation of Standards and topics**

The above depicted framework provides an analytical lens to analyze the standardization process from different perspectives in the IS implementation process. More precisely, it allows not only to ‘blame’ idiosyncrasies characterized to different locales, but also to question if the intended standard rightly addresses the topic?; Is the topic changing from context to context that does not fit the standard’s definition or is that a new case not addressed by the standard? This opens a perspective to analyze the nature of standards and the standardization process, bringing debate of “standard and flexibility” and consequently to “global/local dilemma” into focus in the discussion.

The IS research has posed the question “Where should the balance between the global and the local be drawn” (Roland and Monteiro, 2002:90)? I reframe the question as “Where should the boundary between the information infrastructure and the application using the very infrastructure be defined”? While both questions try to address the same issue, they have different perspectives with regards to the II. The key difference between the two perspectives is that the former refers to the entire ensemble as an II, while the latter divides the II into support infrastructure and the application that is being supported. I argue that the boundary between the II and application should start where the generic nature of the II gets lost and becomes localized to the context of use. It does not further fulfill the requirement of being an
II such as being “open” and “enabling”, but rather becomes a tool or a final product for use. An II is defined as being open, shared, evolving and supportive (Hanseth, 2002; Pironti, 2006), and not a readymade or turn-key solution. This division of II is relative too, because it becomes real in organized practice and the perspective that actors have (Star and Ruhleder, 1996; Jewett and Kling, 1991). For example, for software developers and implementers it is the final product - an application, for health managers it is still an II, who make use of system to process information. “One person’s infrastructure is another’s topic or difficulty” (Star, 1999:380).

Similarly the ICD has been denoted in many ways: standard, list, schema, categorization, classification. This variety of ICD denotations comes from their use in particular context and varying actors’ perspectives. ICD is seen as a standard when it is localized in “standardized paper forms” for recording causes of death, a tool when used by different healthcare administrators and medical practitioners (Bowker and Star, 1999), as communication and control structure when applied to computerized systems, hybrid of work practices and information medium as an II (Star and Ruhleder, 1996). These definitions could well be described from the perspective of actor – standard – topic relationships. What is important for us is to find the borderline at the point where the standard should be included into the II, and at what point it should be application specific. From the definitions above ICD is seen as standard when it is put into paper based form, defining formats of recording ICD codes. These formats implemented in the paper form represent metadata definition of ICD, leaving semantics of ICD open to users’ discretion. We can see now that metadata part of ICD classification is kind of generic and abstract, but local use of it is contextualized and adjusted to local needs and is no more generic.

Thus, standards are built around their topics of interest and topics are managed by the standards. Depending on the topic, standards can fall into one of the three levels: The lowest level – syntactic - is pure technical and is always context free. The second level – semantic - has a dual nature; it is partly technological and partly contextual, and can be termed “semi-generic” (Webster and Williams, 1993). The third level is pure contextual and has limited technological implications, largely dependent on organizational and institutional arrangements arising from the context. These different characteristics of standards determine their relations to the topic, which in turn has implications on actors’ relations to standards depending on actors’ roles in the process of standardization.
The tripartite relationship of actors, standards and topics helps to provide insights into the complexities of standardization process. Conceptual framework also helps in defining approaches for development and implementation of standards in national HMISs and possibly in a large-scale II too.

6.1.2. Facets of infrastructure – a perspective to narrow down the different aspects of the standardization process

The concept of facets of infrastructure could be described as dividing parts of IS development and implementation into correlated facets from organizational, technological and other considerations or the combination of some of them, which could be dealt with in a relative isolation from other parts of II. It assumes bringing together actors, who directly deal and are experts in particular settings of actor-standard-topic relations, as we so earlier multiplicity of actors and diversity of topics makes the process slow, requiring negotiations across diverse communications and viewpoints. Facets of infrastructure are very close in the sense of a layered architecture to the concept of modularization involving different criteria than those of modular approach. While modularization is a solution for adding new features to II without affecting other parts of the system, facets of infrastructure are a way of looking at various aspects (organizational, technical) of II and discovering areas that could be best dealt with in isolation from other facets of an II. Facets of infrastructure can span across different modules, which have relative concerns, involving smaller group of experts in that domain, while adhering to the consistency with the boundary facets of II.

One way of identifying facets of infrastructure is through thematic division, other is prioritization of task to be completed. This involves identification of actors, topics and standards that we can term as who and what and how. These relations can be studied and similar actions, compositions or events could be drawn as recurring patterns, if the same task have been accomplished in similar manner in various locales and resulted in similar outcomes, it can thus easily be predictable to say what possible output of such an action would be. Also generalization of recurring patterns can lead to formation of standard for doing things, composing teams, etc., especially if recurring patterns have global scope (have wider geographic coverage).

Depending on the level of control, facets of infrastructure can be grouped into internal and external. While internal facets are under fuller control of the implementers, the external facets of infrastructure are managed by external entities. In my example, while data, software and
capacity building are largely internal facets and can be shaped by policy development and standardization efforts of the MoH and funding organizations, other facets of the larger infrastructure (e.g. roads, power supply, transport, Internet) are externally shaped under the control of different external actors. Not one actor has control over the entire infrastructure.

With development of concept of facets of infrastructure I have tried to address issues of managing complexity in the process of development and implementation of IIs. Complexity, which is inherent in IIs, grows as the number of components and their integration increases and consequently contributes to the escalation of risk (Hanseth, 2007). Adding new stakeholders to an existing system also exponentially increases complexity, even while benefit from such integration is marginal (Edwards, 2006). Noticeably, inclusion of Civil Registry Office (a subordinate of Ministry of Justice, not MoH) to HMIS of Tajikistan introduced socio-technical complexities and raised political tensions around donor funding.

In the large and integrated information infrastructure spanning across organizational boundaries, the number of links and types of links, between the technical systems and the social/organizational also grows. Technical standardization as a means to solve inter-organizational complexity entails its coordination challenges, as the number of such standards increases (Bygstad and Hanseth, 2011). Bygstad and Hanseth (2011) have thus posed the question of “how can we reduce complexity, both in the development and implementations of large information infrastructures?”

The concept of facets I believe serves as a possible response to the above question. II development and implementation involves complex set of socio-technical decisions to be taken, taking into account varying needs of heterogeneous actors coming from their situated roles. According to Star and Ruhleder (1996), an infrastructure is a fundamentally relational concept, for example while stairs can serve as infrastructure for ordinary people, it can be a potential barrier for handicapped people (Star, 1999). Concept of facets of infrastructure builds on top of above understandings, addressing complexity as an inherent characteristic of IIs. These complexities of IIs are dependent on the number and the nature of the links connecting heterogeneous actor and components, and as such cannot be reduced, unless dropping the links or breaking the whole into parts, which violates the core concepts of II.

Facets of infrastructure tries to address issues related to efficiency of II development and implementation, isolating to a certain extent possible areas of concern from the larger whole while ensuring that the relations between the components of the system are intact.
In HMIS of Tajikistan, the obvious examples are II facets related to data formats and collection, information sharing and ICT. The first concerns with the formats, volumes and content of the data to be collected and their sharing between different actors. The former two are concerned with storing, transmitting and sharing of these data. Now, we can see that two different categories of decisions need to be taken. One is primarily organizational and the other is technical, each requiring specific knowledge of the respective fields. For making data semantics (content) aligned to organization strategies objectives, no much consideration of underlying technology is required, but considered important on the other hand, which is obviously agreed at level of standards ensuring consistency.

Given that the boundaries of responsibility and the necessary steps in maintaining the consistency between intertwined facets is clearly defined, negotiation of involved actors in particular facet of infrastructure could be carried out independently (single facet boundaries). Actors, depending to their roles, can be involved in more than one facet, for example implementers can participate in as many facets as possible, becoming a linking point among the facets they have input in. These relations are explained in section 6.1.1 above.

6.1.3. Perspective for understanding the incremental and transparent introduction of technology as supporting institutional arrangement

I use the concept of “intermediary” to refer to the state of the II where many features of the system are made invisible from direct user access to keep hidden the radical changes embedded in the new technology initiative. The alternative is to try and enable a process of gradual transformation from one state to another. This shift requires time and efforts to adjust organizations through the various degrees and types of institutional changes. Institutional changes do not occur overnight, they are rather results of longer socio-political negotiations among various stakeholders of HIS, who are constantly seeking benefits from it. They are long processes involving deinstitutionalization of old and reinstitutionalization of new practices, which inherently are long term processes (Currie and Guah, 2007). Implementing through short term user trainings are inadequate, as the need is for the underlying technology to be objectified and become deep rooted into organizational routines. Indeed, as Douglas puts it: “although we can say the same thing a hundred different ways over a span of years, there is no way message can be heard until the organizational changes have taken place such that reception is possible” (Douglas, 1986).
Placing existing paper based forms into standardized meta-data definitions, helps creating an intermediary that can comply with the conflicting institutional logics in play. In our case, the system was designed so as to continue the existing system’s look and feel and its centralized logic, while the data is however stored in the standardized definition in the background. This allowed users to analyze data at different organizational levels (logic of “data for action”). Interplay of system users with competing logics, which comes from their organizational principles and external forces, will gradually guide them to build the culture of evidence based decision making.

In the context of health information system in developing countries, a key challenge is around managing the interaction between the introduction of global standards and their local appropriation (Braa et al., 2007; Braa and Hedberg, 2002; Shaw, 2002). A key research finding concerns the use of a “flexible standard” strategy to meet the diversity of information needs, representing a defined set of obligatory data sets for all levels (Jacucci, Shaw & Braa, 2006), while simultaneously giving each level the flexibility to add standards for their local use. While this strategy is best suitable in a context with little or no previously routinized and institutionalized practices for data collection and aggregation, it falls short in a context with a strong existing installed base, where old practices inhibit users from using new features of the proposed system. How to act in this case when a new software solution could be installed in a few mouse clicks, but bringing it to action requires corresponding institutional changes, which are not as easy as this.

According to Star (1999), a smallest obstacle creates barriers to the user of the computer system. This could be a small button click or a link to follow or even a simple lookup on the screen. One of the findings from the studies of users in the Illinois Digital Library Project (Bishop et al., 1999) was that seemingly trivial alterations in routine, or demands for action, will act to prevent users from using the system. This magnification is explained to be related to two simultaneous processes involved: one is users’ action with the computer terminal and the other is assembling these actions within organizational routines (Star, 1999).

Implementing global standards into situated local context is of this nature, especially when implementation is “top down”. “Top-down” approaches typically respond to national needs or to the demands of global agencies (Sahay, 2011), but will necessarily need to interact with local processes and conditions during implementation (Ciborra, 1994). These appropriation
processes are shaped through negotiations amongst actors, often representing diverging interests and needs, with implications on the acceptance or not of the standard.

For the end users of the system, two things are important: input and output, which are definitely linked with their task at hand and is in line with their routinized and organizational goals. Adding additional features or introducing new ways of doing the same thing will challenge system users. During the pilot phase of the HMIS of Tajikistan, many of the new features of the system were ignored. For example, users complained that new system is more complex, while they only wanted to capture, store the data and produce reports, when the new system was meant to provide analytical capabilities. Reducing national data sets to match National Health Strategy (NHS) goals and actual areas of healthcare needing more attention also was rejected by senior ministry officials during the piloting phase. Two competing institutional logics became apparent, users not ready to accept or they got lost in using analytical functionalities of the new system. Despite the fact that the installed base of the existing data standards and system were not satisfactory in terms of functionality, the new system was transparently downgraded, hiding advanced features of the system. The look and feel of the new system also was made similar to the old system and the corresponding reports were designed. While the input and output of the old system was supported by the new system, the standard ways of data handling, storing and analytical functionalities were made invisible to the user. Invisible in a sense that the user will not be disturbed while performing his or her routinized actions, but in case more was needed to be done, it was possible. Other features of the system were available from menu options, and kept voluntary.

Standards and standardization typically imply one another (Timmermans and Epstein, 2010), similarly the topic of standard establishes the standard and the standard shapes the topic. It is important to highlight that not only does global standard impact the local context, but also the local context impacts the direction and quality of global standard. At the very least, this happens because local experience and practice of use of standard provide the fuel for the development of the global standard, but also because social and strategic responses to global standardization challenges constrain and influence the context in which global standards are developed. This happens, for example, through the control structures established at the global level and through the assemblage of stakeholders and stakeholder interests that construct key strategy debates. It also happens through the transfer of social norms and organizational routines, aspirations and ideas that appear in the global network to formulate present and
emergent social engagements, including local improvements of the standards. In short, not only are the local context and global standards intrinsically linked, they are so deeply welded together that we simply cannot address the global standardization challenges. For this, we need to understand and harness the dynamics of local realities that influence them. By the same token, those who wish to capitalize on the potential of uniform solutions will not be able to do so unless they are able to understand and address the great local challenges, which are part of the larger context within which global standards are made.

In our example of Tajikistan HMIS, revision and standardization of indicators took much less time than that of reporting and recording forms, which is yet ongoing. The first reason for this is that recording and reporting forms have been institutionalized and embedded into paper based and later computerized IS, becoming an installed base. But indicators have been calculated on ad hoc basis and there was no any standardized procedure for handling them. The second reason is that revision of recording and reporting forms involved many different stakeholders from the diverse and heterogeneous actors at various levels of healthcare, including hospital managers, statisticians, nurses and medical professionals. Multiplicity of links between various stakeholders creates complexity, each of which requiring consensus and agreement before any change is made.

6.2. Practical implications

Three practical contributions arise from this thesis. One contribution comes directly from my involvement in HMIS design and implementation in Tajikistan through the action research. Other two contributions emerged from theoretical framework and based on empirical findings of this research. These practical contributions are listed below and further elaborated on in subsequent sections:

1. Using three dimensional framework of completeness, fittingness, and actionability for analyzing the data element – indicator linkage

2. Guidelines to composing the right team for the right task

3. Considerations for gradual implementation of software artefacts
6.2.1. Using three dimensional framework of completeness, fittingness, and actionability for analyzing the data element – indicator linkage

The framework of three dimensions of (1) completeness, (2) fittingness, and (3) actionability is specifically designed to analyze data to indicator (mis)matches in HMISs, but could also be used in any other contexts where data warehousing applications are used to find anomalies in the content, quality and quantities of data being analyzed.

The purpose of building and maintaining an information system is to improve the effectiveness of organizational performance. The decisions for the improvements come from the knowledge which resides in the data. Analyzing these data knowledge is generated for taking decisions. For these decisions to be accurate and reliable, data sources and their granularities need also to be accurate and reliable. But this not always the case, public healthcare organizations are constantly changing adapting to the environment, their objectives and strategies also change. Ministries at national level thus prioritize some of the areas that address new realities. In doing so, time by time data of various natures becomes part of HMIS knowledge base, some of which will loosen their actuality.

Three-dimensional framework is designed to analyze anomalies hampering data quality, in other words metadata for collecting health data will be examined. Taking national healthcare priorities, which are monitored and evaluated by indicators as point of departure, framework classifies data at various levels for usability.

The dimension of “actionability” refers to usefulness of indicators themselves. If indicator is used for measuring actual performance of strategic goal of healthcare, such indicator is than classified as actionable. Criteria for actionability come from measurable indicators in NHS and other priorities that are not explicitly shown, or those which appear ad hoc.

Now, that decision on actionable indicators is made, one can find what data are needed for calculating indicator values. The dimension of “completeness” refers to the condition where all data elements needed for calculating indicator value are present in the system. Applying this dimension, new data elements are added and unused are marked for deletion. Once, this process is complete, the third dimension of “fittingness” is applied. In this dimension compliance of data elements for fulfilling indicator(s) criteria are assessed. At this stage various dimensions of data, like periodicity, data element category division, etc. are matched with indicator formulae. Completing these three stages of framework helps to revise metadata definitions for HMIS.
Framework is quite similar to “data cleansing” technique used in data warehousing in ETL (extract, transform, and load) but works at metadata level, not actual data. Framework could be used by health managers and possibly by other professionals dealing with data warehousing as a tool to periodically perform prophylactic analysis of the data being collected and processed.

6.2.2. Guidelines to composing the right team for the right task

Conceptual framework which I presented earlier in this chapter, helps in distribution of tasks among teams and team members in implementation of large scale IIs. In a larger picture, team formations are decided by work requirements and organization objectives, but also there is a need to group people for some concrete tasks. There are permanent teams that work together on a day-to-day basis and the cross-functional teams who work on specific tasks. Then there is the situational task force created to handle a special task. Implementation teams basically bring in change, they are at the heart of IS implementation. They are comprised of individuals who have the skills and knowledge to implement a new tools or processes within an organization either across single or multiple locations. In general, implementation teams have to integrate the specifications developed by the functional experts into a process or facility.

Implementation team does not only include experts in the field, it also includes end users, facility managers, who also participate in the process. Setting a team for situated task could follow understandings coming from concept of “facets of infrastructure”, which also refers to tripartite relationship of actors, standards and topic (in this case implementers, software, context). Following this logic various team members could be grouped to work together for accomplishing specific task in IS implementation.

Balance between members of the teams with regards to tripartite relation ensures competency to address all issues in the particular task. Underrepresentation or overrepresentations are penalizing. Absence of expert in one of areas of interest within the team badly influences the trajectory of implementation. Too many people in the team add more communication and collaboration, complicating the process, even contributing to the delays in implementation.

As Brooks’ law says: “Adding manpower to a late software project makes it late. Adding people to a software project increases the total effort necessary in three ways: the work and disruption of repartitioning itself, training the new people, and added intercommunication. (Brooks,1995:232)”.
It is important to set up teams with over mentioned criteria in mind to avoid failures and delays in large scale IS design, development and implementation. Core to composing teams is to correctly identify relations of members to tools and context.

### 6.2.3. Considerations for gradual implementation of software artefacts

Processes of socio-technical change that are triggered by implementing new software solutions do not occur over short periods of time, subsequently leading to new periods of technological, institutional and organizational change. When software solutions brings in radical changes from both technological and organizational perspectives, it becomes hard to impossible to implement such software product in one go. Such an attempt may result to abandonment of entire process by end users being unable to rationalize them with their daily work practices. There is a need to divide implementation into smaller sets of tasks and introduce them in a gradual way. This technique is actually is foreseen in many modern software product, which are intended to be used by broader community practicing similar things.

In gradual implementation of software it is important for implementers to pay attention to the relation of different parts of software package, user base and primacy of tasks, to determine which features should come first, which one should follow. Piloting DHIS2 in Tajikistan, we have faced such difficulty. For health statisticians in the districts, it was hard to shift from old desktop application called MedStat to the much advanced analytical tool – DHIS2. MedStat had limited data collection and reporting functionalities only. Also these limited set of actions were institutionalized, at the districts level data was collected for upward reporting. No data was analyzed for local decision making and actions. Indicator calculations and managing hierarchies of subordinates among the other features of DHIS2 were new to them.

Knowing that introducing new IS requires much longer time for technology acceptance and organizational changes to take place, we - group of implementers configured DHIS2 in a way that it acts as previous system - MedStat. Even default look and feel of DHIS2 was adjusted for data entry to resemble old system to mitigate the shift. At the same time other features of DHIS2 were active, though not directly visible to end users. When new demands from district health managers were issued, some of new features were taken into use by district statisticians. These demands came from institutional changes at district level through introduction of new financing mechanisms, reorganization of healthcare management system.
Chapter 7

7. Conclusions

The aim of this thesis was to study the nature of the dynamics of local implementation of global standards as a socio-technical phenomenon. A key focus was to focus on understanding issues that come into play and opportunities that rise to draw practical and theoretical insights. The empirical context for this research is primarily the MoH of Tajikistan, a developing country where implementation of the global software solution - DHIS2 is ongoing. Actually, the context is that makes a significant difference in the global/local standardization processes. A large body of IS literature has emphatically established that HIS implementation needs to be sensitive to local contexts (Avgerou, 2002; Walsham 2001), it has also been argued that these global/local collisions are over-emphasized, and that generification and localization of standards and applications are possible through processes of negotiation and discussion (Pollock, Williams & D’Adderio, 2007; Rolland & Monteiro, 2002).

Two key questions posed in this research were wide in scope and required making concrete the unfolding of the described problem into smaller observable parts in the context of standards at global and national levels. In line with this assumption, and the fact that negotiation processes tended to be open and evolving with unpredictable outcomes, I argued that there were particularities that shaped standardization processes, patterns of which could be drawn and reused. Standards studied in this thesis included data sets, data formats, periodicity, data exchange protocols, software, and various routines and practices around data collection, processing, presentation and use. These standards represent techno-institutional components referring to uniform solutions, but paradoxically also contains elements of locality and independence (Bowker & Star, 1999).
Theoretically my research was guided by broader conceptualization drawn from II and institutional theories and standardization literature in IS, which enabled me to examine the challenge of standards from a socio-technical perspective, where information infrastructure is seen as something that evolves over time and also links many institutional and organizational boundaries through the means of standardized applications and procedures. Having this as the “big picture” of the standardization process during an in country implementation of global standards, I tried to decompose this relation into smaller subset of relations, which in turn resulted in a theoretical framework comprised of a tripartite relation of actors, standards and the topics addressed by the standards.

The theoretical framework developed in this thesis proposed a conceptual linkage between the actors, standards and the problem addressed by the actors and standards, reflecting its content or topics. The relationship between actors (as human agency) to standards and topics was embedded in various kinds of institutions and infrastructures and shaped by incentives they receive from doing (or not) of certain actions. These relations are shown by splitting and unpacking of technological, social parts from reality for analytical purposes; they are nevertheless are a “single whole”, including political and cultural dimensions. The theoretical framework allows the study of how this “single whole” is made up?, what relations hold it strong or make it weak?, and the knowledge of which then could be used to formulate approaches and strategies for standardization process in the course of IS implementation.

As such, the theoretical framework tries to reduce complexity (reduction through isolation) of the standardization process by unpacking the techno-social dimensions and examining various relations drawing patterns of recurring events and structures as a proven way of doing. Perhaps these patterns are not specific to the locale but rather to the composition of actors involved and tasks they perform or problem they address, and may hold potential to under similar issues in other contexts. This complexity of the IS implementation within the large II is characterized by heterogeneity of actors, and especially human actors having different viewpoints and coming from various institutional contexts and carrying varying political agendas. The same equally applies to global standards that require aligning to the local settings. The general strategy developed here is to deal with complexity by isolating smaller parts (have higher inter-relations) from the “single whole”, while the holistic approach of II remains intact. Small correlated parts interface with the larger whole by
“boundary objects”, which in turn could be the topic of other problems, actors’ interests, and standard setting and so on.

Strategies and approaches developed here are grounded in theoretical insights and empirical findings of this thesis that are useful in the study of global/local interplay of standards, especially when it takes place inside the larger II of multilevel organizations. The theoretical framework provides for an analytical lens allowing formulations of approaches and strategies for practical use in IS standardization, including assessing its sustainability. This is possible through mechanisms of incentives, arising from domain problems and actor satisfaction. For example, key benefits for practitioners would arise from reduced time through avoiding unnecessary communications, and making common mistakes.
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