

Exploring the Institutional Logics and Complexity of Health Management Information System Implementation

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To the Asangansis
(Dad, Mum, Ini, Uko, Jnr, Iman, Eno,
&
my wife, Olivia, and son, David)

for all your love and support

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ACRONYMS & ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal care
AR	Action Research
BHC	Basic Health Center
CAR	Canonical Action Research
CAS	Complex Adaptive System
CHC	Comprehensive Health Center
CIDA	Canadian International Development Agency
CPM	Cyclical Process Model
CRHDSS	Cross River Health and Demographic Surveillance System
CR-SEEDS	Cross River State Economic Empowerment Development Strategy
DFID	Department for International Development
DHIS	District Health Information System
DOS	Disk Operating System
DPRS	Director, Planning Research and Statistics Department
EDI	Electronic Data Interchange
FMOH	Federal Ministry of Health
GDP	Gross Domestic Product
GH	General Hospital
GIS	Geographic Information System
HC	Health Center
HDCC	Health Data Consultative Committee
HDSS	Health and Demographic Surveillance System
HERFON	Health Reform Foundation of Nigeria
HIFA	Health Information for Action
HIS	Health Information System
HISP	Health Information System Programme
HIV	Human Immunodeficiency Virus
HMB	Hospital Management Board
HMIS	Health Management Information System
HSDP	Health Systems Development Programme
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
IDRC	International Development Research Center
IFIP	International Federation for Information Processing
IL	Institutional Logics
IS	Information System
IT	Information Technology
J2ME	Java 2 nd Micro Edition
JCHEWS	Junior Community Health Extension Workers
LEOs	Local Engagement Officers
LGA	Local Government Area
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
mHMIS	Mobile-supported HMIS
MIS	Management Information System
MNCH	Maternal, Neonatal and Child Health
MOH	Ministry of Health

MS	Microsoft
NCC	National Communications Commission
NEHSI	Nigeria Evidence-based Health Systems Initiative
NEHSI-HDSS	NEHSI - Health and Demographic Surveillance System
NGO	Non-government organization
NHMIS	National Health Management Information System
NPM	National Programme Manager
OpenHDS	Open source Health and Demographic Surveillance System
OpenMRS	Open source Medical Records System
PATHS	Partnership for Transforming Health Systems
PHC	Primary Healthcare
PRRINN	Partnership for Reviving Routine Immunization in Northern Nigeria
PRRINN-MNCH	PRRINN & Maternal, Neonatal and Child Health
RCA	Researcher-Client Agreement
ROI	Return on Investment
RQ	Research question
SEEDS	State Economic Empowerment Development Strategy
SHMT	State Health Management Team
SMOH	State Ministry of Health
SMS	Short Message Service
SPHCDA	State Primary Health Care Development Agency
TBAs	Traditional Birth Attendants
UK	United Kingdom
UN	United Nations
US(A)	United States (of America)
USAID	United States Agency for International Development
USD	United States Dollar
VHEWs	Voluntary Health Extension Workers
VHW	Village Health Worker
WHO	World Health Organization

ABSTRACT

Health management information systems (HMIS) in developing countries are often not successfully implemented, and thus are often unable to support the much-needed management of health programs. The HMIS literature is replete with the difficulties and complexities of HMIS implementation, and the resulting significant proportion of implementation failures. Prior research has linked HMIS implementation difficulties and complexity with barriers and gaps in understanding the important role of organizational factors in the HMIS implementation process. In particular, because of the multiplicity of participants in the process, an implementation is often complex because there are multiple internal and external organizational participants of different kinds and at different hierarchical levels (sub-district, district, state and national). Each participant has its own perspective and belief system, which in this thesis is conceptualized as the participant's institutional logics. Thus, implementations often have to battle with the multiple institutional logics through which participants - such as the donors, the health ministry and technologists - contest the process.

Existing research suggests the lack as well as the consequent need for a conceptual framework to understand the multiple institutional logics that influence an HMIS implementation. This thesis, through an institutional logics lens, aims to fill this gap by exploring how key institutions and their underlying logics influence an HMIS implementation and contribute to its complexity.

The research was essentially interpretive but also action oriented. It engaged the context and derived knowledge through the act of implementing an HMIS. It utilized an action research design based on two HMIS implementation projects in Nigeria. Data was collected primarily through participant observation and informal interviews.

The thesis makes both theoretical and practical contributions.

Theoretically, it contributes three frameworks: 1) an HMIS institutional logics framework, for understanding how institutional logics may influence an HMIS implementation; 2) a conceptual framework for HMIS implementation complexity, which shows what makes implementation projects complex and how institutional complexity can be conceptualized through institutional logics; and 3) an implementation tension resolution framework, which is a theoretical perspective for understanding the resolution of conflicting logics and the tensions created in HMIS implementation projects.

Practically, two contributions are made: 1) direct contributions to the empirical context from the HMIS implementations at the site of the action research, and 2) insights into managing the complexity of an HMIS implementation.

By considering HMIS implementations within an institutional logics framework, this research will contribute theoretically to a hitherto under-researched empirical domain area (HMIS) from an institutional perspective. The practical implications for HMIS implementation will help managers, practitioners and administrators improve implementation planning and design. These practical implications may help policymakers to reformulate and reassess implementation strategies. The research supplements the body of empirical research on HMIS implementations in the Nigerian context, about which little has been published and which is generally an under-researched empirical setting in the information systems literature. HMIS implementations are crucial for Nigeria (and other developing countries), since better, successful implementation strategies could unlock the anticipated benefits of the HMIS, and thus improve health care on the whole.

CHAPTER 1: INTRODUCTION

1.1 Area of Concern: HMIS and its Implementation

Health management information systems (HMIS) research has become a significant area of investigation within the research domain of information systems for societal development. HMIS here simply refers to public sector information systems for health management at the community, district, state and/or national levels. In most developing countries, health care is largely a government function; and the HMIS provides the foundation for decision-making within health ministries and departments (AbouZahr and Boerma, 2005; Lippeveld et al., 2000; Stansfield et al., 2008). HMIS are designed to provide health-related reports (e.g. on healthcare delivery, workforce, health financing, disease surveillance, vital statistics such as deaths and births, etc.) in order to “assist the managerial monitoring and control of organizational functions, resources or other responsibilities” (Heeks, 1998, p. 2) within the ministries or departments of health.

The last two decades has seen HMIS research focus more on understanding implementation, which simply is the critical process from making a decision to adopt an innovation or artifact (in this case, the HMIS) to the routine use of the innovation or artifact (Klein and Sorra, 1996). According to Fleck (1994), this important process is an organizational learning process through which technical and organizational resources are configured together to make a system routinely used. In line with this, Kwon and Zmud (1987) have emphasized that a deep understanding of the information system (IS) implementation process and the rationalities and influences that affect it would allow practitioners and researchers develop more effective and successful implementation strategies. The better the management of the implementation process is, the greater the chances of implementing a system that becomes successfully entrenched and useful to the organization (Chan and Swatman, 1998; Ginzberg, 1979). Accordingly, within the context of HMIS in developing countries, there is increased focus on achieving a deeper understanding of HMIS implementation. This is, arguably, also for two main reasons: 1) the increased urgency and necessity for HMIS implementation and 2) the significant proportion of failure of HMIS deployment.

1.2 Motivation: Increased Urgency/Necessity for HMIS Implementation

There is an urgent need for HMIS implementation at global, national and local levels. At the global level, powerful impetus has come from commitments, both political and financial, to meet the United Nations 2005-2015 Millennium Development Goals (MDGs) (UN General Assembly, 2000; United Nations, 2005), of which three goals are health-related and are expected to be monitored and evaluated using information from the HMIS. At the national level, in Nigeria, where this research is based, a strong HMIS is considered an urgent necessity for the newly democratically elected government whose constituency demands proof of progress in meeting promised health-related reforms (Federal Ministry of Health, 2010). As the national health policy document (Department of Health Planning Research and Statistics, 2008) asserts, the HMIS is the central pillar for monitoring health care programs and helping policymakers to ensure that health care is delivered to every community and locality. At the local level, the urgency is fueled by the expectation that citizens will be empowered by information that will allow them to participate in their own health care, especially as the government promises to provide a decentralized and locally owned health system.

The absence of a functioning information system to guide health planning and decision-making in Nigeria contributes to the abysmal state of health in the country (DFID, 2012; HERFON, 2008), which is rated as one of the ten worst countries in Africa in terms of its morbidity and mortality indices (Antai, 2009; Hogan et al., 2010; Mo Ibrahim Foundation, 2012; Wakabi, 2013). Consequently, there is a dearth of data to help policymakers understand what the prevalent health problems are and what resources exist to tackle them. Yet, despite this heightened need for and surge in interest in HMIS implementation, deployments continue to record a significant proportion of failures. Thus, the anticipated benefits of the HMIS (which is to provide the much needed health data) have yet to be fulfilled (HERFON, 2008, 2011).

1.3 HMIS Implementation Failure: Complexity

A significant proportion of HMIS implementations fail (Heeks and Bhatnagar, 1999; Heeks, 2006; Heeks et al., 2000; Littlejohns et al., 2003; Mutemwa, 2006). Empirical research shows that this has been the case in the setting of the Nigerian HMIS (Adindu and Babatunde, 2006; Anifalaje, 2012; Asangansi and Shaguy, 2009; Department of Health Planning Research and Statistics, 2008; HERFON, 2008; Sambo et al., 2006). As a result, planners, policy makers and managers in Nigeria do not have the information that they need to make decisions about health programs (HERFON, 2008, 2011).

HMIS implementation failure, in Nigeria and in other developing countries, has been attributed to operational and organizational issues. Operational factors mentioned include: poor transportation, impeding the flow of the HMIS workforce and the flow of data; an insufficiently skilled workforce; insufficient funding; insufficient supplies (paper forms/registers and stationery); poor telecommunications (though this is improving dramatically now as mobile phone penetration rates increase); and poor power supply. Consequently, HMIS data collection has continued to be poor, or nonexistent, in much of Nigeria (and other developing countries), especially at the lower levels where healthcare is delivered (such as in health care facilities in local communities), where these problems are starker (HERFON, 2011; Kanjo, 2012a, 2012b; Ngoma et al., 2012; Odhiambo-Otieno, 2005a). In response to some of these constraints, improved web-based and mobile-supported HMIS have been deployed. However, improved technology does not necessarily repair the deep-seated organizational issues underlying HMIS failure.

Empirical research has shown that a large number of HMIS implementations resulted in failure because their technical aspects were given emphasis while their organizational context was neglected (Anderson and Aydin, 1997; Heeks, 2006). Moreover, some have argued that the HMIS operational problems themselves have underlying organizational undertones (Kimaro and Nhampossa, 2005). According to (Heeks and Kenny, 2002, p. 3), the organizational costs for managing the planning, training, and maintenance of information and communication technology (ICTs) is estimated to be more than ten times that of the acquisition cost of the technological artifacts and infrastructure themselves. Researchers have explored the organizational aspects of information systems (IS) even further; reporting that the implementation of large scale IS (of which the HMIS is an example) is usually problematic because of its highly political nature (Bunduchi et al., 2005; Markus, 1983; Sahay et al., 2009; Schmidt and Werle, 1998). For example, in discussing the challenges faced by the introduction of geographical information system (GIS) for management of land in India, (Puri, 2007) mentions the role of politics, particularly concerning how the scientists were in conflict with the local community over control of the local mapping. In the

same vein, Silva and Figueroa (2002) explore the role of power and politics, particularly that exercised by international agencies in implementing ICT in developing countries. Similarly, some researchers have shown how some unsuccessful implementations in Sub-Saharan Africa have resulted from donor-recipient conflicts (Braa and Hedberg, 2002; Mosse, 2004; Wild and Domingo, 2010). Overall, researchers studying HMIS in low resource contexts (Braa et al., 2007; Mosse, 2004) emphasize the predominant role that organizational aspects play in HMIS implementation.

Thus, preceding HMIS research suggests that successful HMIS implementation is not merely about deploying new technologies, but also about being sensitive to and managing the organizational change and underlying institutional processes that surround it (Webster, 1995). That is, even if appropriate technical solutions are identified, these cannot be implemented and institutionalized without appropriately understanding the different organizational stakeholders involved (Shaw, 2009). As Lippeveld and Sapirie (2000, p. 249) put it, “the success of a health information systems reform depends not only on technical improvements but also on in-depth understanding of political, socio-cultural, and administrative factors.” According to this view, an information system implementation (especially in developing countries) (Walsham et al., 1988) involves a complex socio-political system including people and practices immersed in the peculiarities of the context (Kling and Scacchi, 1982), with power structures playing a role (Ash et al., 2007; Kimaro and Sahay, 2007; Walsham and Sahay, 2006). Thus, the implementation reaches beyond technological factors to incorporate the complexity of social, organizational and cognitive realities (Avgerou, 2002). Accordingly, Heeks (2002, 2006) notes that any IS implementation design must meet the social reality on the ground, in order to avoid what he calls the “design-reality gap,” which often leads to failure.

However, in this thesis, I posit that there is not just one social reality on the ground, but that there are in fact many realities, because of the multiplicity of participants in the process. As Mosse (2004) describes, the situation, especially in developing countries, is often complex because there are multiple administrative partners, different kinds of participants involved and a multiplicity of hierarchical levels (sub-district, districts, province and national) in the HMIS, each with its own information needs. Trying to harmonize and cater to these different needs is a complex undertaking but one that needs to be done (*ibid*).

In Nigeria, for example, the empirical context of this study, researchers have specifically pointed out that the health system and consequently the HMIS, are influenced by many semi-autonomous agents especially the donor agencies, vertical federal government programs and the semi-independent Nigerian states, each exerting their own nuanced interpretation of policy. For example, the federal government, states/districts and interested donors are often in a tussle over interpretations of health financing arrangements, and how funds should be allocated to budget lines – this in itself leading to an enormous complexity in national project implementations (see Ekpo and Ndebbio (1998; 2006) for extensive discussions of this). In this vein, other researchers (Bernardi and De Chiara, 2011; Jamali and Neville, 2011, 2011; Thieren, 2005) advocate that understanding and managing inter-organizational aspects of implementation is something crucial for the success of HMIS in low resource settings. In line with this, (Chilundo and Aanestad, 2005) based on their analysis in Mozambique similarly opine that understanding the multiple belief systems that guide different participant interpretations and thus shape implementations is a requirement for successfully implementing the HMIS, and a main step towards developing strategies to reduce failure rates. An emerging body of literature is focused on this -

understanding the multiple belief systems that may influence an IS implementation process - through an institutional lens, utilizing the concept of *institutional logics* to achieve an in-depth analysis of the organizational context of the HMIS. This thesis, likewise, draws on this emerging conceptual perspective of institutional logics.

1.4 Conceptual Approach: Institutional Logics

The notion of institutional logics is a sociological concept that refers to belief systems adhered to by a group of individuals, influencing their actions and giving “meaning to their activities” (Scott, 2000, p. 20). Institutional logics “provide the formal and informal rules of action, interaction, and interpretation that guide and constrain decision makers in accomplishing the organization’s tasks” (Thornton and Ocasio, 1999, p. 804). They function as the organizing philosophies that shape the behavior of participants (e.g. in an organizational IS implementation). Because they refer to a collection of belief systems and related practices, they structure the perceptions of and construct meanings for participants. Thus institutional logics are an important notion for understanding organizations (Friedland and Alford, 1991; Scott, 2000).

Examples of pervasive societal institutional logics include the (bureaucratic) state, family, democracy, the (capitalist) market, and religious inclinations (Friedland and Alford, 1991), and community (Marquis and Lounsbury, 2007). Each of these institutional orders is framed by its specific institutional logic that provides its frames of reference and defines scripts for organizational practices (Friedland and Alford, 1991). Institutional logics provide form and structure for the different worlds of participants and give their actions meaning.

The concept has been applied to theorizing information systems implementation in organizations in a considerable variety of research domains (see (Thornton and Ocasio, 2008)). Particularly, in relation to this thesis, it has been used in the setting of developing countries such as India (Nicholson and Aman, 2012), Brazil (Hayes and Rajão, 2011), as well as in the health domain (Bernardi and De Chiara, 2011; Currie and Guah, 2007; Gutierrez and Friedman, 2005; Koç and Vurgun, 2012; Sahay et al., 2010; Yeow and Faraj, 2011). Mostly, these authors discuss how institutional logics are embedded within HMIS implementation, and how an HMIS implementation is an organizational change process involving multiple institutional logics. Institutional logics are inscribed into and embedded in the implementation process, as participants call for their own viewpoints (representing their dominant logics) to be implemented.

A particular focus of research in this area has been on the complex situations where these logics compete or conflict. For example, Gutierrez and Friedman (2005) explain that HMIS project expectations and goals often expose contradictions in the different institutional logics in a setting. They argue that HMIS implementation design and planning efforts often involve incompatible perspectives and logics and represent a natural source of contradiction. Similarly, Currie and Guah (2007), on analyzing the HMIS in the United Kingdom, describe healthcare as “infused with institutional logics”, “politically contentious...and various stakeholders including clinicians, managers, administrators and patients interpret and re-interpret these logics” (p 237).

They suggest that one of the most significant challenges facing HMIS implementation is to “reconcile competing institutional logics” (p 245).

Within HMIS implementation research in developing countries, some authors (Avgerou, 2004; Bernardi and De Chiara, 2011; Sahay et al., 2010; Wahid, 2012a, 2012b) have hinted at some logics and rationalities as well.

Avgerou (2004) articulates, in her analysis of an HMIS implementation in Jordan, that the implementation project had to satisfy two lines of authority with divergent logics -- the local bureaucratic structures of the health services, and the USAID (United States Agency for International Development) mission, -- whose essential values and fundamental principles about development and organizing were in conflict. She describes that they clashed on many issues, and highlighted two main conflicts: one between the logics of decentralization and centralized control; and another involving the scope of intervention, that is, a tension between a 'vertical' focus on reproductive health by USAID and a horizontal broad focus on primary health care by the ministry (Avgerou, 2004).

Another researcher in this emerging space, Wahid (2012b), in his analysis of the Indonesian eProcurement system at the ministry, exposes that the interplay and transition between logics can lead to organizational change and can inform a strategy for enrolling partners. He explains how each local government had its "own logics in adopting the eProcurement system, and within each local government, stakeholders also express their various assumptions, values, and beliefs about using the eProcurement system" (Wahid, 2012b, p. 4). He narrates that initially, "the institutional logic behind this initiative was to overcome corrupt practices in public procurement by adopting an eProcurement system to facilitate a more transparent and accountable process" in order to get the buy-in of funders (Wahid, 2012b, p. 10).

Nevertheless, as the project progressed and funding was acquired, the initial accountability logic gave way to an economic (cost-reduction) logic, which became a new and dominant institutional logic behind the government agency. And "they put this (economic logic) at the top of the priority list to convince other government agencies" to buy in (Wahid, 2012b, p. 11). However, after enrolling them, they again shifted the dominant logic to an efficiency logic where the narrative was that the IS could improve the management of procurement at the ministry by making it faster and less stressful for staff (especially as procurement for the ministry became less political). In summary, he discussed the dominant institutional logics and the transitions between them as well as how they influenced the implementation trajectory. These logics included: transparency and accountability logic, with the adoption of the eProcurement system to increase the transparency and accountability of the public procurement processes; efficiency and economic logics, with the adoption of the eProcurement system to improve efficiency in the public procurement evidenced by the percentage of savings (cost reduction); and 'better process logic', which made the officers feel more comfortable with usage of the eProcurement system (as indicated by reduced politicization of the process).

Sahay et al. (2010), through reflection on their case (the Tajikistan HMIS), brought another angle to an institutional logics approach to HMIS implementation research by emphasizing further the need to generally theorize HMIS from an institutional logics perspective. They identified that exploring more generally the different forms of logic at play within HMIS implementation would be a strong contribution to HMIS research, and an important area for further research, especially within developing settings (Sahay et al., 2010). Their work suggests that a framework that explores HMIS institutional logics is an important research gap in the literature. This thesis aims to contribute to filling this gap.

In addition, Sahay et al. point to another research gap in the area of understanding how conflicting or competing logics are resolved, especially in relation to understanding the organizational change processes involved in HMIS implementation e.g. the deinstitutionalization of logics. This requires understanding the conflicting logics and how the conflicts between these logics are resolved in an empirical context. This thesis attempts to fill this gap by analyzing the conflicting logics at play in the Nigerian HMIS context. In addition, it aims to further the existing literature on institutional logics in HMIS implementation in low resource settings. Besides, it will also augment the existing HMIS/IS research literature on Nigeria, which is currently scant, and which, within the context of the institutional logics perspective, is largely absent. Thus, apart from the empirically driven motivation to improve the HMIS in Nigeria, addressing these research gaps also adds to my enthusiasm for the research in this thesis.

1.5 Aims, Research Questions and Expected Contributions

Building on the foregoing, especially the hints and clues from previous research on HMIS institutional logics as well as the research gaps identified, this research aims to theorize more deeply and broadly the institutional logics of the HMIS. This will help us better understand the HMIS implementation process and trajectory, as well as comprehend how the nature of participants' logics can influence it. Particularly, this thesis will explore three research questions:

Research question 1 (RQ1): How do institutional logics and their interplay influence and shape the HMIS implementation process?

(‘process’ here refers to the trajectory and course of the implementation. ‘Implementation’ is as defined in the opening section – section 1.1 - of this thesis).

Research question 2 (RQ2): How can institutional logics help us understand the complexity of HMIS implementation?

(‘complexity’ here refers what difficulty of implementation due to the intricacies of organizational factors that need to be dealt with – as discussed in section 1.3, and conceptualized further in section 3.5).

Research question 3 (RQ3): What are alternative approaches to resolving conflict within existing logics?

By tackling these research questions, this thesis (using an institutional logics perspective) aims to contribute to the domains of HMIS and IS implementation research (especially those with an inter-organizational or multi-participant nature).

Both theoretical and practical contributions are envisaged:

Theoretically, three specific contributions will be targeted based on these three research questions. First (and following from RQ1), this study will attempt to put together a **framework for understanding how institutional logics may influence an implementation process**. Second (and following from RQ2), by understanding HMIS logics, I expect to achieve some understanding of what makes implementation projects complex at an institutional level, especially in a typical developing country setting. This contribution is achieved by developing a **framework for understanding institutional complexity** and by applying this framework to reflect on HMIS implementation. In other words, I will use an understanding of institutional logics to make an argument about how institutional complexity can be conceptualized.

Thirdly (and following from RQ3), I will propose an **implementation tension resolution framework** that can contribute to a theoretical perspective for understanding the resolution of conflicting logics and the tensions they cause in HMIS implementation projects. The latter two contributions appear to be generalizations that can exhibit plurality and are thus potentially reusable beyond the context of HMIS, making them potentially also broader contributions to IS literature as a whole, particularly in the area of inter-organizational and multi-participant implementation contexts.

Overall, by placing HMIS research within an institutional logics framework, this research will contribute theoretically to a hitherto under-researched empirical domain area (the HMIS) for the application of the institutional perspective.

This research also has **practical contributions**:

Firstly, there are **direct contributions to the empirical context** - the site of this action research - in the form of the action of implementing the HMIS there. Secondly, from a practical perspective, this thesis will shed **practical insight into managing the complexity** of the HMIS implementation process. The aim is not to make guidelines or 'rules for success' but to improve our understanding. Drawing practical implications for HMIS implementation from the improved understanding can help managers, practitioners and administrators improve on implementation planning and design. These practical implications can help policymakers reformulate and reassess implementation strategies. Finally, the research will **supplement the body of empirical research on HMIS implementation in the Nigerian context**, about which little has been published and which is generally an under-researched empirical setting in the information systems literature. HMIS implementations are crucial for Nigeria (and other developing countries), since better, successful implementation strategies could unlock the anticipated benefits of HMIS, and thus improve health care.

1.6 Research Approach and Empirical Framework

The research approach is interpretive and based on an action research design employing mainly the techniques of participant observation, discussions (including informal interviews), and document analysis.

The empirical framework is based on my direct involvement, from 2008 to 2013, in implementing HMIS software through two action research projects in Northern and Southern Nigeria respectively, with a practical motivation based on the urgent need to help establish a robust Nigerian HMIS - an HMIS that by necessity has to be implemented successfully, even if it must struggle to overcome conflicting institutional logics before it can do so.

When I started this research, I was intrigued and wanted to know more about why implementing an HMIS is so challenging. As the research progressed, the institutional nature gradually became more obvious, leading me to refine my question and focus in that direction (as is common within any hermeneutic process). Consequently, I focused my approach to draw on the institutional logics perspective – because of its fit to the research concern. (I discuss more on this choice of conceptual framework in chapter 3, and I discuss how it is used in chapter 4, the methodology chapter). Overall, my analysis is based on the HMIS implementation projects (with the involved participants), focusing on the institutional logics at play.

1.7 Structure of Thesis

The rest of the thesis is organized as follows:

Chapter two describes the setting of the research in terms of the historical, political and socioeconomic context of the HMIS in Nigeria, and highlights the key drivers for the work on improving the HMIS. This chapter also introduces the two projects that formed the basis of my fieldwork.

Chapter three provides a critical review of the literature on institutional logics, detailing the relevant and related concepts and terms and motivating the theoretical approach to addressing the research questions.

Chapter four presents the research approach utilized, including the interpretive nature, the action research, the fieldwork, my role as researcher and my approach to analyzing the data.

Chapter five is focused on the findings. It will give an account based on the research papers (also included in the appendices), and will end with a summary.

Chapter six details the contributions (theoretical and practical) of this thesis, and ends with some concluding remarks on possible trajectories for future research.

CHAPTER 2: RESEARCH CONTEXT AND EMPIRICAL SETTING

This chapter offers an overview to the context and the real world challenges that motivated my exploration of the Nigerian HMIS. The chapter provides a summary of the historical, political and socio-economic context of the HMIS in Nigeria, as well as the key drivers for improving the HMIS. The chapter also outlines the two projects that formed the basis of my fieldwork: the PRRINN Project in Northern Nigeria and the NEHSI-HDSS project in Southern Nigeria.

2.1 The National context, Nigeria

With a population of about 170 million, Nigeria is the African continent's most populous country and accounts for about half of West Africa's population (The World Bank, 2012). The population is unevenly distributed across the country, with half of the population concentrated in a few main cities, while the other half of the national population lives in the much more expansive rural areas (National Population Commission, 2010; Ngowu et al., 2008).

Administratively, Nigeria is a federal republic of 36 constitutionally semi-autonomous states, with a central administration at the federal capital territory, Abuja. Each state consists of local government areas, at times synonymously referred to as districts, as in this thesis, and which are further subdivided into wards. The country is run by a nationally elected president and a two-tiered legislature, the National Houses of Assembly (parliaments). Each state is administered by an elected Governor and a corresponding state parliament elected by its own people. Similarly, local governments (or districts) and wards in each state are governed by elected Chairpersons and Councilors respectively.

Culturally, Nigeria has over 250 different ethnic groups, and over 250 indigenous languages. The three main languages spoken are Hausa (mostly in Northern Nigeria), Igbo (in the East of Southern Nigeria) and Yoruba (West of Southern Nigeria). The official language is English dating back to British colonial rule.

Historically, after British conquest of much of West Africa, Nigeria was created as a country in 1914, from the economically inspired merger of two district British colonies (the Northern Nigeria Protectorate and the Southern Nigeria Protectorate), and remained under colonial rule until its independence in 1960. Post-independence, Nigeria has been characterized by political instability, ethnic strife, North-South tensions, a 30-month civil war (ending in 1967), and three decades of a series of military dictatorships (ending in 1999). Nigeria regained democracy in 1999, and is seen as an example of a successful but eventful transition from autocratic to democratic rule. However, despite 14 years of continued democracy, it continues to struggle with continuing strife, corruption and poor socioeconomic development.

Despite being an oil-rich middle-income country, the 31st largest economy in the world, and among the ten fastest growing economies (7% annual growth rate) and a fair average gross per capita income (2420 USD), the majority (68%) of Nigerians live below 1.25 USD per day (ranking a poor 146th in the world ranking) (The World Bank, 2012). There is a huge rich-poor gap, and some states especially in the North and Central regions have much worse indices for poverty. Infrastructure in Nigeria is largely poor: Motorized transport, electricity supply and fixed line telecommunications remain poorly developed. However, the rapid growth of the mobile industry and the now high mobile penetration – 86% by June 2013 (NCC, 2013) - is providing a new platform for connectivity and socioeconomic development. Nevertheless, the widespread poverty translates into poor living conditions, poor hygiene, lack of access to safe water and sanitation and, on the whole, a poor public health situation.

2.2 Poor Public Health Situation

Nigeria remains among ten countries with the world's worst public health indices (Antai, 2009; Hogan et al., 2010; Mo Ibrahim Foundation, 2012; Wakabi, 2013): maternal mortality is as high as 1200 per 100,000 live births in some states, which is approximately three hundred times more than the average in, for example, Italy (with 3.9 per 100,000 live births). Similarly, infant mortality is among the world's highest; for instance, the last WHO published figures (2003) had infant mortality as high as 100 deaths per 1000 births, compared to 64 in neighboring Ghana and approximately 4 in Norway and Italy in the same year (World Health Organization, 2012).

At independence in 1960, Nigeria inherited a weak public health system from England, whose focus in the colonial era was mostly on urban and curative services (Asuzu, 2005). Subsequently, the health system went through three unsuccessful National Development Plans and health policy reforms and did not have a comprehensive strategy until the popular 1978 World Health Organization declaration on Primary Health Care at Alma Ata – a declaration to which the country was signatory. However, though the National Health Policy that was promulgated had primary health care as the main thrust, it suffered from poor implementation especially during the three decades of military rule that followed. However, with return to civil rule in 1999, public health has been at the top of the agenda, with an expansion of primary health care delivery, and a commitment to meeting the long-term United Nations–sponsored Millennium Development Goals (MDGs). Under the MDGs initiative, which covers the years from 2005 to 2015, Nigeria is committed to achieving a diverse range of ambitious objectives involving poverty reduction, gender equality, health, education, improving the environment, and fostering international development cooperation. In an MDGs update released by the World Health Organization, it was found that Nigeria was making progress toward achieving several goals but was far from achieving others (WHO, 2012). Specifically, and commendably, Nigeria had advanced efforts to protect the environment, develop a global development partnership and provide universal primary education. However, the country lagged behind on the health-focused goals of combating infectious diseases such as HIV/AIDS, tuberculosis and malaria, reducing child and maternal mortality, and as well as the goals of eliminating hunger and extreme poverty (FMOH, 2011; Iwuoha, 2013; WHO, 2012).

According to the government and numerous researchers/practitioners (Aindu and Babatunde, 2006; Anifalaje, 2012; Federal Ministry of Health, 2010; HERFON, 2011; Ngoma et al., 2012), one major challenge to reaching these goals has been the challenge with measuring and monitoring progress, and guiding activities using evidence from captured information. The lack of evidence to guide decisions has been attributed to the absence of a robust national health management information system (HMIS) that can provide the much-needed information.

2.3 The Nigerian HMIS

The Nigerian government has long considered the application of ICT as vital to improving the monitoring and evaluation of its health system via strengthening the system of data collection from health facilities and communities. The availability of accurate and timely data is thought to be fundamental to improving decision-making within the public health administration, and could help move the country away from its poor healthcare indices. Thus within the ICT policy of Nigeria (FMCT,

2012), the healthcare sector is a priority area, and within the health policy, the establishment and maintenance of a robust national health management information system (HMIS) is a stated priority (Department of Health Planning Research and Statistics, 2008).

The Nigerian HMIS is responsible for data management and statistics within the health ministry at national, state, and district levels. It was established as a "management tool for informed decision-making at all levels" (Department of Health Planning Research and Statistics, 2008, p. 18), functioning to assess the health status of the population, identify major health system problems, and monitor progress towards stated goals. Data flow was designed to be hierarchical, and in a command-and-control organizational structure that reached from communities to health facilities to districts, to state, and then to the federal level. However, although administrative positions were set up and staff employed, the HMIS remained dysfunctional and has remained so today, especially in the states without donor support. For example, HMIS forms are sometimes unavailable at health facilities, health workers are not trained on how to fill the forms, and filled forms are often not submitted. According to the MoH, in their HMIS Program of Action (Department of Health Planning Research and Statistics, 2008),

“As a result of neglect and underfunding over the years, the National Health Management Information System suffered a lot of setbacks and could not meet the objectives for which it was set up. It has been defective and hence it is not possible to calculate even the simplest indicators” (p 24)

HMIS - historical context

The weakness of the HMIS in Nigeria has a historical parallel to that of the health system as well as the political system as a whole (Asuzu, 2005). From the colonial era, through many decades after independence and until the 1990s there was no HMIS structure in Nigeria. It was in 1992 that the HMIS framework was articulated in response to the promulgation of National Health Policy, which provided, for the first time, the establishment of a coordinated and robust countrywide health management information system (Department of Health Planning Research and Statistics, 2008). A HMIS work plan was devised (in 1996) and implementation commenced (in 1997) in a number of states, with support from donors (World Bank and the UK Department for International Development) (Heywood, 2008). In the late 1990s, when donor support fizzled out, in relation to escalating sanctions on the military government, the project failed. However, with a successful transition from military to democratic rule (in 1999), sanctions on funding from the donor governments were lifted later in 2000 and initial HMIS funding came in through the USAID-funded VISION program. This was collaboration between the US-based EngenderHealth, Johns Hopkins University and other partners (Akpan et al., 2004). Working with the Federal Ministry of Health, the VISION program implemented the country's first computer-based HMIS in 2001 through pilots at Bauchi, Oyo and Enugu states. This system, Health Information for Action (HIFA), was proprietary (not open-source) and was DOS-based. It was based on the EpiInfo 6 and EpiMap 2 software applications (Dean, 2000) and was network-aware (Akpan et al., 2004). Its implementation represented the first introduction of computer technology for the HMIS. However, the implementation encountered a number of challenges that included the use of a dataset that was too large, lack of provision of forms at the facility level, an unfriendly command line user interface, poor

interconnectivity, multiple parallel systems and a challenge with addressing multiple interests of stakeholders (Akpan et al., 2004). The project ended after the scheduled time, the ministry abandoned the system and HMIS activities were again underfunded in those states for a few years.

However, the project did reveal the need to move away from the paper based HMIS with its many problems including poor access to the stored information; data in paper forms not being easily analyzable or presentable; taking a lot of time to extract; lacking durability; requiring enormous storage space and being generally cumbersome and ineffective.

These are major problems the computer-based system helped address. Nevertheless, it also highlighted the need to understand the wider organizational setting of the HMIS and the Ministry of Health.

In 2003, after the VISION pilot projects had ended, the United Kingdom-sponsored Partnership for Transforming Health Systems (PATHS) project started in six Nigerian states (Heywood, 2008). This program (PATHS), working with the South African Health Information Systems Programme (HISP) team and utilizing principles that had been learned and adopted from similar HMIS work in South Africa and other countries in (HISP) network, introduced an open source software, the District Health Information System (DHIS). The DHIS is a software application developed for public health management information systems by the international HISP group. It had been continuously adapted for field conditions by participatory effort between health care and software professionals, in several developing countries since 1994. HISP began in the Western Cape of South Africa in 1994, with the development of data forms for Primary Health Care and the development of the DHIS. From the initial pilots, it spread to the rest of South Africa as well as many other African and Asian countries, and now a global network with a coordinating node at the University of Oslo. From 2003, HISP South Africa working with the PATHS project helped develop local capacity to deploy and maintain the DHIS in Nigeria. Their DHIS pilot was successful and continued beyond the end of the PATHS project in June 2008. In 2006, during the DHIS implementation by the six states supported by the PATHS project, based on an open tender process, the DHIS was adopted by the Federal Ministry of Health as national standard for the HMIS and countrywide implementation was planned. The DHIS has been scaled up, through many projects and phases, and by 2011 have been deployed to all states in the country (Asangansi and Shaguy, 2009). However, the nationwide implementation has occurred uncoordinatedly and haphazardly by numerous nongovernmental organization (NGOs) using the system. Today, the states continue to struggle with the structural and technical aspects of maintaining a HMIS especially in extending its reach to the lowest level of health care, to provide the much-needed information for health care planning and management. By structural and technical aspects, I refer to the socio-organizational structure and technical components of the Nigerian HMIS.

Figure 2.1 below provides a summary of the timeline of major activities related to the HMIS. (I have also added at the end, the projects my research is based on.)

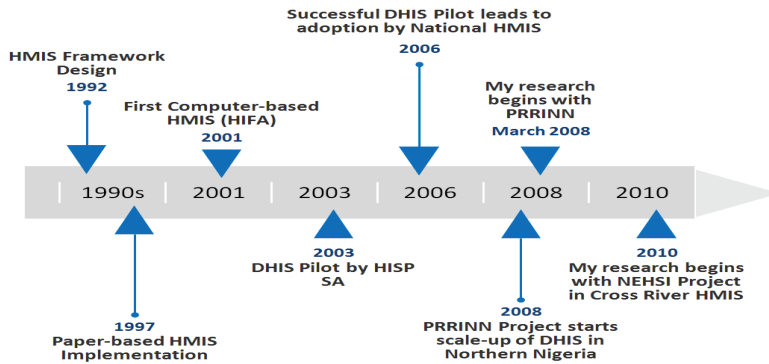


Figure 2.1. Timeline of HMIS implementation

2.4 HMIS Structure

The Nigerian HMIS is structured in accordance with the national health policy and can be discussed as being made up of a number of components. These components include the people working in the system (human resources), the tools (paper- and computer-based) they use, the data involved and the processes involved in managing the data - all of these occurring at the different levels of hierarchy, which mirrors the health system (Asangansi and Shaguy, 2009). The HMIS hierarchy is organized in a manner that allows it to obtain information from all levels of the health system. Data flows from the lowest levels, the individuals and the community, to the facility and up the hierarchy through the local government areas (LGAs) and state government levels to the national/international levels.

Figure 2.2 below shows the data flow in the Nigerian HMIS. In theory, data forms filled by the Village/Voluntary Health Workers (VHW) from **communities** are sent to healthcare facilities through the Junior Community Health Extension Workers (JCHEWs) (In practice though, I have found that only few VHWs and JCHEWS work regularly and systematically at community level).

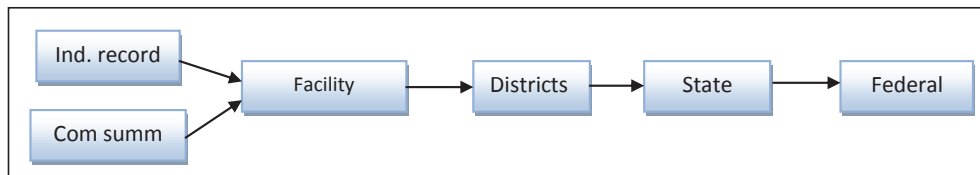


Figure 2.2. Data Flow in the HMIS. (Ind. Record = Individual records; Com sum = Community summaries)

When **clients** visit facilities, they are given a **child/personal health card**, on which basic personal information is recorded and updated on subsequent visits. **Daily registers** have been developed and placed in healthcare facilities for standard-based health data collection countrywide. These daily registers are used to record activities in the outpatient, antenatal clinics, labor and delivery, family planning, nutrition/growth monitoring clinics, immunization and in-patient.

The data in the registers are summarized monthly into a **health facility summary form**. Health facility summary forms are sent to the respective local government area (districts) – to the attention of the PHC coordinator. Information from the health facilities is aggregated in the **LGA summary form**, which in turn is sent to state HMIS unit. The state HMIS unit then forwards a summary of the state data to the relevant departments and units within the state such as the the Epidemiology Unit, special health

programs, etc. The state NHMS Unit sends summary returns to the Federal NHMS Unit, which also disseminates reports to other federal level departments and programs as well as international agencies and programs. See Table 2.1 below for the list of HMIS forms/reports and table 2.2 for actors in the HMIS.

Table 2.1 Data tools in the National NHMIS

Level	Forms
Federal	NHMIS Federal Summary form – Form 004
State	NHMIS State Summary Form 003
District	NHMIS Local Government Area (LGA) Summary Form 002
Health Facility	NHMIS Summary Form 001 – Health Facility Summary Forms
	Revised Community Outreach Register- sent by JCHEWS to facility
Community-Based	Various Tally Sheets for Trace Diseases, Antenatal Care, Family Planning, Pregnancy Outcome, Mortality and Births, Community Activities,
	Referral Slips for Emergency Cases and for Routine Cases
	Revised Community Outreach Register – Form 000
Individual Record	Child Health Card
	Personal Health Card

Table 2.2 Actors in the Nigerian HMIS (modified from Asangansi and Shaguy, 2009)

Level	Actors
Federal	Epidemiologists, information officers, health administrators, elected political officers, international partners, local NGOs, consultants, health activists, researchers, program officers donor agencies, nongovernmental organizations, vendors, consultants, Federal Ministry of Health
State	Epidemiologists, health administrators, information officers, elected officers, partners, researchers, local NGOs, consultants, State Governor and State Ministry of Health
Local government (district)	district information officers, PHC Department Officers, Local government chairman (elected), vertical program officers, District head (traditional ruler)
Facility	Patients, health records officers, healthcare providers
Community	Village/voluntary health workers, Junior Community Health Extension Workers (JCHEWS)

2.5 The two HMIS Projects

This thesis is based on a study of two HMIS projects in Nigeria. The projects involve improving the HMIS in Nigeria – with their primary locations in Northern and Southern Nigeria respectively. The first and main project (Northern Nigeria based) utilized an approach involving improving HMIS data submission and flow from **health facilities to the state level**, while the second project (in Southern Nigeria) was based on improving data submission and flow from **communities (villages) and households to the state**. Both involved introducing the national HMIS software, the **District Health Information System (DHIS)** to the state level, as well as introducing **mobile phone based data collection** by health workers (**health facilities workers** and **community field workers** respectively). Very little has been written on the HMIS in Nigeria, including these states (Asangansi and Shaguy, 2009).

2.5.1 The first project: The Partnership for Reviving Routine Immunization in Northern Nigeria (PRRINN) Project in Northern Nigeria

This project is a part of the HMIS strengthening efforts through the Partnership for Reviving Routine Immunization in Northern Nigeria & Maternal Newborn and Child Health Initiative (PRRINN MNCH Initiative, or PRRINN for short). In this section, I describe the context of this project especially regarding the area and socio-organizational context, the problem and challenges as well as the approach taken.

Area and Socio-organizational context - Northern Nigeria Context

The PRRINN project is an initiative that aims to address maternal and child health issues in the Northern Nigeria states of Katsina, Zamfara, Yobe, and Jigawa. The program considers the strengthening of the HMIS to be a major strategy to achieving its aims.

The major language spoken in Northern Nigerian states is Hausa, much of the population is Muslim, and the people are predominantly farmers. The region has also been in the news for the multiple religious crises and insecurity (especially in the last five years). At the same time, states in Northern Nigeria typically have the most dire health indices in the country especially for maternal, newborn and child health and have been the major focus for international aid and donor involvement (Doctor et al., 2011; Wall, 1998). The region is characterized by extremely low levels of health service utilization, the existence of polio and measles outbreaks, low staffing levels and low skill levels of existing staff, absence of significant infrastructures other than mobile connectivity and low antenatal attendance and very high maternal mortality (Doctor et al., 2012; Wall, 1998).

My work in PRRINN focused mainly on Katsina state (though my consultancy involved some work in the other 'PRRINN states' – Zamfara, Yobe and Jigawa). With a population of approximately 6 million, Katsina is Nigeria's fourth most populous state – and sixty percent of the population is rural (National Population Commission, 2010). It has a low GDP per capita; over 70% of the population subsists on under 1USD per day and unemployment is over 25% (National Bureau of Statistics, 2012). Katsina State is divided geopolitically into 34 districts. The state has one of the worst indices for maternal and child health in Nigeria, and is considered by the federal government as an educationally less developed and disadvantaged state (Department of Economic Planning, 2005). Successive governments in Katsina State have continued to invest in primary health care (PHC): recent efforts have been aimed at building and rehabilitating PHC facilities, provision of equipment, and the establishment of mobile ambulance services particularly in the state's difficult-to-reach and rural geographical areas (Katsina State Government, 2012). However, management systems such as the HMIS have not received much focus, as priority is given to more 'tangible' goods such as drugs, health personnel, and buildings. This is the case in much of Nigeria, where investing in public health management resources is often in tension with providing physical deliverables in a sociopolitical system where the masses are desperate for tangible results from the polity.

The HMIS is weak, as in the rest of country, and has been unable to meet its function of providing the much needed information to guide planning and action. According to a HMIS situational analysis in Katsina and other PRRINN states, HMIS paper forms were mostly unavailable at health facilities, health workers were not trained on how to fill the forms, and filled forms were not submitted. At the community level, data collection was almost non-existent, and important health events at the village level went unrecorded and unreported.

During a situational analysis in Katsina, the state HMIS officer pointed out that resources were grossly inadequate especially human capacity, and that there was a lack of political will or support in providing the HMIS forms and materials (Anifalaje, 2012).

There are many challenges here including the difficulty with distribution of data collection materials to district facilities, the difficulty with maintaining computers in the district and facilities because of the hardy environment; weak financial support and lack of, or at best unreliable supply of electricity. In addition, transportation between the state and the districts is difficult, because of bad roads and challenging terrains especially to and from rural areas. Paper forms were largely unavailable as the state had failed to provide them, reports from the facilities were submitted late to the district and data quality (completeness, timeliness) was poor.

Often improvised paper forms and registers are relied on for data collection and aggregation, from facility, through local government (district) authority level, and up to state level. However, resources are so limited, even the submission of monthly reports is often delayed because staff do not have money to transport the forms from the LGA level to the State HMIS offices. The approach by the PRRINN project was based on a philosophy of working with the Katsina State government and districts to improve the HMIS through improving the political commitment to the HMIS as well as building local technical capacity. It had a goal to establish an information system that could track, monitor, and evaluate progress as well as help strengthen the capacity of state and local government health departments to plan, make decisions and act, based on health data. In addition, the PRRINN project was interested in quickly establishing a monitoring and evaluation (M&E) system to collect data that could be used to demonstrate progress to stakeholders and funders.

One of the key strategies of the project was to improve the organizational coordination of the HMIS, especially as the situational analysis also found that there was poor coordination between the different participants in the HMIS implementation process. (More on this discussion in the findings and contributions chapters).

2.5.2 The second project: The NEHSI-HDSS Project in Cross River, Southern Nigeria

The Nigeria Evidence-based Health System Initiative's Health and Demographic Surveillance System (NEHSI HDSS) project (2010 to 2012) was based on strengthening the community level HMIS in Cross river state (Southern Nigeria), through developing and implementing health and demographic data collection for the DHIS-based HMIS.

The project (and consequently this study) was done within the context of the Nigerian Government's commitment to a comprehensive health sector reform that focuses on developing responsive primary health systems at the grassroots - the district and community levels. It was designed and funded within the framework of the NEHSI project. NEHSI is a collaborative initiative between the Nigerian Government's Federal Ministry of Health, the Cross River State Ministry of Health, the IDRC (International Development Research Centre, Canada), CIDA (Canadian International Development Agency) and two universities (University of Southern Maine, USA and the University of Calabar, Nigeria) (International Development Research Centre, 2009). The NEHSI project aimed to support the ongoing health reform in Nigeria through "strengthening local monitoring capacity and fostering a strong, action-oriented evidence base towards the establishment and sustenance of a responsive primary health care system" (International Development Research Centre, 2009). A major thrust of NEHSI's approach was the development and implementation of community monitoring systems linked to district health information systems, such that they can support the generation and use of evidence on health service delivery at the community and district levels. It involved the use of mobile technology to improve HMIS but working from the community level (as opposed to the facility level in the PRRINN project). The initiative involved improving the collection and transmission of health data from the villages and communities to the data managers at the state, through the application of mobile technology.

The project was implemented in Akpabuyo, one of Cross River State's 18 local government areas (districts). Cross River state lies in Nigeria's coastal Delta region where it shares the South Eastern border with Cameroon. With a population of about 2.9 million, it is Nigeria's 27th most populous state but the 19th largest with an area of 21,636 km² (National Bureau of Statistics, 2012; National Population Commission, 2010). It is mainly an agricultural state with about 75% of its people engaging in subsistence agriculture (State Planning Commission, 2008). Recently it has become Nigeria's major tourist attraction and has a GDP per capita of 3150 USD (above the national average). However, over 70% of the population live on under 1.25 USD a day and the state has among Nigeria's worst indices for poverty, food supply, HIV/AIDS, and maternal and child health; and is considered by the Federal Government as an educationally underdeveloped state (State Planning Commission, 2008). Specifically, the implementation focused on Akpabuyo district, which was selected because it had among the poorest health indices (maternal mortality, etc.) within Cross River State (Meremikwu et al., 2011).

The context of this project epitomizes the challenge with scaling the National HMIS beyond the districts and large health facilities to the 'last mile', the communities and the informal setting of villages, where a significant proportion of health-related events occur. In such context, the HMIS data often represents only a tip of the iceberg, missing a substantial amount of important health-related activities in the communities (Kanjo, 2012a; Odhiambo-Otieno, 2005b; Tolentino et al., 2005). Efforts at monitoring events within communities in Cross River (as in the rest of Nigeria) have often failed, or become dysfunctional, beset by poor supporting infrastructure such as erratic power supply, poor road transportation and poor telecommunication as well as a general lack of appropriate technology. Consequently, community-based HMIS data collection is often poor, or nonexistent.

This means that the much needed health data from communities and villages are not available to the state – leading to a significant informational gap that handicaps health planners and decision makers. Particularly, it has been challenging to collect data from Nigerian communities for many reasons. It is difficult to maintain computers in the villages because of the hardy environment and the enormous cost considering the scale of such an effort. In addition, these communities are largely excluded from the electrical grid, and even when on the grid, receive too little supply of electricity. In addition, transportation within the villages and between the villages and district and states are difficult because of bad roads and challenging terrains especially to and from rural areas. It is therefore not surprising that though the HMIS policy stipulates that data collection should occur from the villages and communities, it has remained largely unimplemented, beset by the aforementioned operational complexity and difficulty. This project aimed to meet with these challenges.

A mobile-based community data collection solution was proposed and implemented to address the discussed challenges. However, such a system needed to build on the paper system, which was weak. Thus, the first step was to properly implement the paper-based solution and later build the mobile-based system on top of that. This approach would help in the training of the main participants in the system, as well as provide some foundation to build on, for subsequent work on the mobile-based system.

The paper-based system involved four groups/levels of participants: community field workers; (community field) supervisors; state data clerks and server admin (data manager) at the state.

The project operated as follows: community field workers visit households and collect health data using paper forms. The paper forms are submitted to supervisors who vet the quality of the data before they can be transferred to the data clerks for data entry onto the server based at the state level. A mobile data collection system to improve the transfer of data from the communities to the state using mobile technology was developed and implemented. The system involved data entry at the point of collection (households visited) with immediate submission to the server. This significantly improved the ease of data collection – and consequently data quality.

With implementation, the system was reported to be effective in improving the data collection process and the quality (timeliness and correctness) of the data collected. As one of the community field workers said; “this makes it so easy for our work, no need to carry so many forms to the data office”. The management was equally happy that the system allowed for timely collation and streamline data entry.

2.6 Conclusion

This chapter has provided empirical details of the historical, sociopolitical and infrastructural context in which this research was conducted. It highlighted key development concerns of the setting and has highlighted the projects that form my empirical framework. Please see table 2.3 below for a summary.

Table 2.3. Summary of both HMIS projects

States	Key actors	Technology	Goal	Implementation period	My role
Katsina state (also Yobe state)	PRRINN-MNCH project, DFID (funder), state and local governments, national and state HMIS offices, health facility workers	DHIS 1.4 then DHIS2.0; J2ME (SMS) Mobile App, SMS Modem	Report summary health data from health facilities to HMIS (DHIS)	2009 - 2012	Involved in design, development/building, implementation and training
Cross River state	NEHSI project, IDRC (funder), state and local governments, Universities of Calabar & Southern Maine, national and state HMIS offices, community health workers	DHIS 2.0, Opendatakit (Android) App, OpenHDS middle-ware	Report health and demographic summary data from communities to the HMIS (DHIS)	2010 - 2012	Involved in design, development/building, implementation and training

In sum, this chapter has made an account of how the Nigerian healthcare system and the HMIS have evolved, and is useful for understanding the underlying context of problems and solutions that this thesis focuses on. Particularly, it situates the organizational complexity and infrastructural challenges that HMIS implementation faces in the setting. As the discussion in the chapter illustrates, the HMIS is a complex collection of multiple actors and stakeholders and much of the activities around the HMIS involves getting these different actors at different levels to interplay for data flow to occur across the country. A major challenge, however, is that the work is inter-institutional and involving many different actors with their different institutions which have different perspectives, sometimes leading to conflicts when perspectives clash. Particularly, the government has identified that a central problem to HMIS implementation is “lack of clarity... and the absence of a strong central co-ordinating institutional framework” (Department of Health Planning Research and Statistics, 2008, p. 36). However, to build such a framework, there is a need to understand the different belief systems and views by the different participants and players. The next chapter frames the analytical notions I have adopted to help in pursuing this understanding.

CHAPTER 3: CONCEPTUAL FRAMEWORK

In this chapter, I introduce and explain the conceptual notions that guide the problem formulation, research design and analytical approach for this thesis. By presenting these notions, I aim to achieve the following: to explain why this conceptual approach was adopted and what its underlying theoretical assumptions are; to clarify the research questions, and thus position this inquiry relative to the relevant literature; to establish what is known and what is unknown in order to spell out the research gap and identify the contributions; and to explain how the concepts help guide the research process and analysis.

The central concept for this thesis is institutional logics (Friedland and Alford, 1991; Thornton and Ocasio, 2008), and I am interested in exploring the logics of the HMIS and in unpacking HMIS implementation complexity from this perspective. While the analyses in this thesis are shaped by my views, I largely build on, synthesize and further extend the growing literature on institutional logics. However, before going into details on what the institutional logics perspective entails, in the following section, I pause to inform the reader why I have chosen this conceptual perspective for the research.

3.1 Why Institutional Logics

In choosing this perspective, much thought has been given to the research aim, which relates to achieving a deep understanding of the institutional nature and the underlying logics that may be involved in an HMIS implementation process. Essentially, I discuss four reasons why this perspective is an appropriate lens:

Firstly, and fundamentally, it is a sociology-inspired perspective for theorizing HMIS implementation. By using sociological concepts, we gain better explanatory power and vocabulary to gain insights into organizational issues and the context of implementation of information system (IS) artifacts (Avgerou, 2000; Kling, 1993; Orlikowski and Baroudi, 1991). In HMIS research, in particular, it has been demonstrated that sociological theories can significantly improve our understanding of the organizational contexts where a health information system is deployed and used (Berg, 2001; Chiasson and Davidson, 2004; Heathfield et al., 1997; Lorenzi and Riley, 1995). In addition, the choice of a sociological perspective helps situate this work rightly within an information systems tradition that shuns a technological deterministic view of technology, which is a reductionist view that presupposes that technology is *the* key influence of organizational change. Rather I have embraced a balanced, socially informed and context sensitive view that HMIS implementation is also largely an organizational change process involving technology, people and institutions.

Secondly, the institutional logics perspective inherits important theoretical assumptions from decades of work on institutional theory and then improves on it. One of the leading organizational theories used over the last four decades is institutional theory, which has proven to be useful in empirical organizational analysis, especially in unpacking issues related to organizational change encountered in IS implementation. It also attends to and gives theoretical scope for interpreting salient aspects like legitimacy, power and societal influences on the organization. HMIS implementation is an organizational change process involving these aspects—hence, this perspective can significantly enrich our understanding. In addition, as discussed later, this institutional logics perspective addresses some

of the recent critiques of institutional theory such as concerns around agency and a better explanation for organizational change and heterogeneity. In fact, some institutional theory researchers (Nicholson and Aman, 2012; Thornton and Ocasio, 2008; Thornton et al., 2012) now believe that, moving forward, the institutional logics concept is the core and central enhancement to (and the next major wave of) the institutional theory.

Thirdly; recently, the institutional logics lens is interested in and contributing to the understanding of complexity. A way of understanding the complexity, or complexities, of the social world (in which IS implementation takes place) is to focus on aspects of multiplicity, heterogeneity and coexistence of different modes (or logics) at work (Grisot, 2008). These are aspects that the burgeoning institutional logics approach is beginning to tackle, and recent publications such as (Greenwood et al., 2011) within this budding body of literature hint at insights that may help us theorize the complex nature of HMIS implementation, which is a major goal of this thesis (research question 2).

From my literature assessment, it appears that neo-institutional theory may have been weak in explaining complexity because it focused more on explaining why organizations look the same i.e. homogeneity, as espoused in the concept of isomorphism (DiMaggio and Powell, 1991). Whereas the institutional logics perspective potentially explains both why organizations may look the same (because of similar logics at play) or why they may be different (because of the variance and heterogeneity of dominant logics in organizations). The approach I have thus taken to contribute to understanding complexity, using institutional logics, is to unpack it and break it down into components (such as multiplicity, heterogeneity, conflicts, historical embeddedness, power and identity) from an institutional logics perspective. Using the institutional logics framework allows such an approach, as I will address in the institutional complexity section of this chapter.

Fourthly, the institutional logics perspective provides a more comprehensive alternative to similar concepts. While there are a couple of concepts that appear to be connotatively similar, the institutional logics concept appears to be the most appropriate of them for this research. The notable similarities include: the concepts of technological frames of reference (Orlikowski and Gash, 1994; Orlikowski and Gash, 1992), corporate logics (Jackall, 1988), logics of action (Boltanski and Thévenot, 2006; DiMaggio, 1991), interpretive schemes (Greenwood and Hinings, 1988) and the concept of conceptions of control (Fligstein, 1985, 1987, 1993). The latter four are essentially precursors and antecedents to the institutional logics concept and I refer the reader to (Thornton et al., 2012, pp. 3, 27, 33) for an excellent discussion on how they have informed and contributed to the institutional logics perspective, which has essentially subsumed many of their assumptions.

For the sake of brevity, I discuss further here the only one that is not mentioned in that discussion, technological frames of reference. From my reading, it appears institutional logics can be considered similar to the concept of technological frames of reference because the technological frames concept comparably acknowledges that diverse groups have dissimilar perspectives on the use of technological artifacts and that these different perspectives or viewpoints are profoundly significant in organizational perceptions and can influence IS implementations (Davidson, 2006; Dougherty, 1992; Orlikowski and Gash, 1994; Porac and Thomas, 1990). Like institutional logics, the technological frames concept also has cognitive connotations, and frames of reference can include assumptions, knowledge and expectations expressed through language, actions and stories. However, the concept has been mainly developed within the school of thought of social shaping of technology, which has seemed to focus

(successfully though) on showing that people's interpretation influences and drives information technology adoption and use, and in so doing, disproves technological determinism, which maintained that technology evolves in its own course, without human influences (Orlikowski and Gash, 1994). Yet technological frames has not proven very useful in institutional analysis (including those involving legitimacy and multilevel analysis linking back to underlying institutions in society), which we are concerned with in this thesis. There are also pointers in literature to support the weakness of the technological frames in unraveling institutional (and organizational/sociological) issues in information systems: for example, Egyedi (2000) in discussing standardization concurs that institutional theory (and its relations) provides much better clues in analyses related to institutions than theory built on the social shaping of technology and technological frames literature.

Overall, the institutional logics concept has great explanatory power, as it is based on the established sociology-based literature of institutional theory. It 'stands on the shoulders' of decades of institutional theory research. Take for example, in trying to analyze the logic of automation to save cost (technology for cost reduction in businesses), it is possible to link to an underlying institution, capitalism, a society level institutional logic, which itself has long standing research. By being able to do this, we can link local practice within organizations to broader societal movements, and be able to discuss phenomena at multiple levels of society. Through such linkage, the institutional logics perspective potentially provides a simple yet elaborate conceptual structure that can provide a parsimonious approach to analysis (not needing too many adjunct concepts).

In sum, without going into an ideological debate about the 'best theory' or best general theoretical approach (as there is nothing like that, and it will be presumptuous to think there is), I have aimed to be theoretically rigorous in this research by being open about my choice of analytical approach and the thinking underlying it.

3.2 Background: The Institutional Perspective

3.2.1 Organizations, Institutions and Institutionalization

Broadly speaking, an **organization** is a social unit (group of people) with a common purpose to achieve a collective goal (North, 1991). Organizations are everywhere, at different levels, and are involved in every sphere of human action. They range from manufacturing firms, schools, social movements, and government departments to organized gangs, families, internet mailing lists and open source communities. The rules that guide how organizations and their members behave are known as institutions (North, 1991). According to North (1991), while organizations and entrepreneurs are the players, **institutions** are the rules they play by. Institutions are durable social structures consisting of norms, routines and practices (Scott, 2001). Institutions signify a socio-organizational pattern or order that has attained a certain property or state (Jepperson, 1991). When a new institutional practice or order is well established, the practice is said to be **institutionalized** (i.e., institutionalization has occurred) (Jepperson, 1991, p. 145). **Institutionalization** is thus the process whereby individuals within organizations become accustomed to the rules, norms and meanings of the institution (Tolbert and Zucker, 1983). Deinstitutionalization is the reverse, the eroding of such institutions, with its norms, rules and meanings (Dacin et al., 2008; Oliver, 1992).

Family, marriage, insurance, aid, healthcare and hand shaking are examples of forms that represent institutions. The HMIS has also been described as an institution with its practices, rules and norms (Kimaro, 2006). The local institutionalization of a HMIS, for instance, involves creating new roles, meanings, structures, responsibilities and technical procedures for the production of health information, as well as financial plans and budgets to ensure that the system becomes part of the existing social structures, routines, and cultures (Kimaro and Sahay, 2007).

Institutionalization processes establish **practices**, and these practices such as data collection and reporting routines within the HMIS, may become accepted with time as normal and routine. Routines are also sustained by shared assumptions about their necessity and legitimacy, which may not necessarily be based on technical benefits and efficiency but on survival within their socio-political environment (Meyer and Rowan, 1977). As institutions become established, the extent of their institutionalization increases as features, roles, and meanings increase (Machado-da-Silva et al., 2005). Institutions are typified by their stability, their ability to provide individuals with legitimacy and their ability to shape action and individual behavior. The degree of institutionalization of systems or practices depends on the degree to which the actions of members in an organization have a shared meaning and value, and recognized legitimacy (Jepperson, 1991). The notion of institutionalizing change represents a particular change that is becoming part of the everyday and ongoing activities of the organization. Change is considered institutionalized if employees who had previously used a different workflow start to use the new steps of the redesigned workflow to do the work without anyone prompting those (Jacobs, 2002). Thus, a particular information technology (such as DHIS) is institutionalized when it eventually loses its separate extraneous identity and becomes an element of the organization's ongoing activities.

3.2.2 New Institutionalism

The basic concepts of institutions and institutionalization as discussed above were laid down by what is now considered 'old institutionalism'. Old institutionalism has an extensive past beginning with early empirical analyses of organizations and their institutional environment (Selznick, 1949, 1957) and the early theorizing by (Parsons, 1956) that highlighted how institutions help to integrate organizations in society through conventions, rules, and power, usually through an institutionalization process.

Nevertheless, in the last four decades, this now 'old' institutional thinking became a foundation for the new institutional perspective (or new institutional theory), which emphasizes the roles of **legitimacy** (Meyer and Rowan, 1977) and of **regulative, normative and cognitive pressures** on organizations (DiMaggio and Powell, 1991; Scott, 2001). According to this 'new institutionalism', **legitimacy** rather than efficiency is the main explanation for survival, success, and change in organizations (Tolbert and Zucker, 1983). Organizations survive by conforming to their external environment through striving for legitimacy.

Three pressures, cognitive, normative and regulative, demonstrate different kinds of legitimacy. The **normative** pressure refers to norms and values that point to the prescriptive and moral aspects of organizational behavior, and emphasizes the influence of expectations from peers. Here, change stems primarily from the professionalization of practices, and how peers in such practices offer prescriptions,

for example, guidelines for their professions (Kimaro, 2006; Suchman, 1995). For example, data collection practices in HMIS often change or are established on the advice of consulting professionals or respected HMIS experts.

The **regulative** pressure on organizations emphasizes conformity to rules and laws (Scott, 2001), and involves rule setting and endorsement activities such as policies, rules and decrees. For example, national HMIS bodies provide policy and regulation (standards) that implementing organizations must align to, if they must survive.

However, from a cognitive perspective, routines are often followed because they are taken for granted as technically efficient and accepted, without assessment of their outcomes. Here, change occurs by organizations voluntarily imitating and modeling themselves on other successful organizations and behaviors (e.g., what is considered 'best practice'). Thus, the **cognitive** view (also referred to as mimetic view) defines institutions by their systems of meaning, that is, their common beliefs and shared logics (Scott, 2001). This view concerns human inclinations, motivations, and how they are socially constructed. Overall, new institutionalists mostly emphasize the cognitive dimension of institutions and pay attention to how individuals interpret or perceive data within their shared frames of meaning (DiMaggio and Powell, 1991; Scott, 2001).

In sum, the essential idea in neo-institutionalism is that these three forces (cognitive, normative and regulative) are legitimizing forces that make organizations conform to the institutional rules in their environment (Meyer and Rowan, 1977), thus making them appear similar in form and structure. This similarity in form and structure is what is referred to as **isomorphism**. Essentially, isomorphism has been defined as a constraining process that makes a unit (e.g. an organization) in a population to be similar to other units that encounter or face similar environmental conditions (Hawley, 1986), and is considered to be a major force for organizational change.

Neo-institutional theory (with its central concepts of legitimacy and isomorphism) has been applied to many aspects of the HMIS in developing countries by many authors (e.g. (Bernardi, 2009; Bishaw, 2008; Jamali and Neville, 2011; Kimaro and Sahay, 2007; Kimaro, 2006; Latifov and Sahay, 2012; Machado-da-Silva et al., 2005; Mekonnen and Sahay, 2008; Sheikh, 2009; Wahid, 2012b) .

While there have been many empirically diverse explorations, there is ample room for more theoretical contributions from these developing world settings. In this vein, moving forward, joining the theoretical discussions in literature would require engaging with emerging and developing concepts such as institutional logics.

In addition, despite the many accomplishments and rich insights that new institutionalism provides on how macro structures and culture shape organizations and the role of legitimacy, critiques have poured in that the neo-institutional approach failed to explain agency and the micro foundations of institutions, institutional heterogeneity and change (Thornton et al., 2012). The last decade has seen the emergence from the institutional literature of the institutional logics concept to meet with these criticisms. It is a concept that incorporates the macro structure, agency and multi-level processes (society, organizational, individuals) and explains how institutions enable and constrain decisions and actions (Thornton et al., 2012). In this emerging institutional logics perspective, the focus is no longer mostly on legitimacy, but on the effects of the different institutional logics on organizations and individuals in a broader variety of contexts, including industries, markets, and populations of organizational forms. By

providing a link between actions and institutions, the institutional logics approach (Thornton and Ocasio, 2008) provides a bridge between, on one hand, DiMaggio and Powell (1991) and Zucker's more micro-level process approach (Thornton et al., 2012; Zucker, 1987) and, on the other hand, the macro, structural perspectives of Meyer and Rowan (1977). Friedland and Alford (1991) argue that society and social relations are not just about the diffusion of structures based on the legitimacy seeking nature of organizations (as in neo-institutionalism) but about rationality and influence of institutional logics.

3.3 Institutional Logics

Institutional logics refer to belief systems that are carried and propagated by a collection of individuals, guiding their actions and giving "meaning to their activities" (Scott, 2000, p. 20). They "provide the formal and informal rules of action, interaction, and interpretation that guide and constrain decision makers in accomplishing the organization's tasks" (Thornton and Ocasio, 1999, p. 804). They function as the organizing principles that influence the behavior of participants (e.g., in an organizational IS implementation). Because they refer to a set of belief systems and related practices, they define the meaning and content of institutions. Thus institutional logics provide a link between institutions and action, and are an important conception for understanding organizations (Friedland and Alford, 1991; Reay and Hinings, 2009; Scott, 2000; Thornton and Ocasio, 2008).

Empirical research indicates that institutional logics exert influence by shaping the rules by which reasoning takes place and how rationality is perceived and experienced (Thornton and Ocasio, 1999). Examples of pervasive societal institutional logics include the (capitalist) market logic, democracy, the (bureaucratic) state, family and religious inclinations (Friedland and Alford, 1991; North, 1991), and community (Marquis and Lounsbury, 2007).

Each of these institutional orders is defined by a specific institutional logic that provides a frame of reference, outlines scripts for the institutionalized practices and specifies bases of legitimation. Institutional logics provide form and structure for the different worlds of participants and give their actions meaning. These symbols and practices are available to organizations, groups and individuals to manipulate, elaborate further, and use to their own advantage (Friedland and Alford, 1991, pp. 232, 248, 251–252). Put succinctly, institutional logics are the ways particular social worlds work (Jackall, 1988, p. 112). It defines what is taken for granted and what appropriate or legitimate behavior is. Institutional logics provide social actors with a sense of self (that is, an identity).

Institutional logics has been used within numerous domains (see reviews by Thornton and Ocasio (2008) and Thornton et al. (2012)). More specifically, and relevant to our concern, the concept has been applied to understanding implementation research in the developing world public sector (Hayes and Rajão, 2011; Nicholson and Aman, 2012), as well as the health domain (Bernardi and De Chiara, 2011; Currie and Guah, 2007; Gutierrez and Friedman, 2005; Koç and Vurgun, 2012; Sahay et al., 2010; Yeow and Faraj, 2011). These authors hint at how institutional logics are embedded within health information systems implementations. HMIS implementation is an organizational change process involving multiple institutional logics. These logics are inscribed into and embedded in the implementation process, as participants call for their own viewpoints to be implemented.

One of the remarkable conceptions of the institutional logics thinking is that while the traditional (old and new) institutional approaches allow organizations only a limited response repertoire, with its sole prescription being conformity and legitimacy, the institutional logics perspective suggests that legitimacy by an organization does not necessarily lead to conformity and isomorphism (Thornton et al., 2012). Essentially, since organizations interact with each other in the context of numerous and potentially conflicting demands coming from various logics, they can obtain more latitude to resist and give themselves more scope for strategic manipulation and flexibility (Can, n.d.). Thus while institutions constrain action they also provide sources of change and agency. By agency, I refer to a social actor's ability to have effect on the social world, potentially altering the rules and reinterpreting logics by combining them (Scott, 2008; Thornton et al., 2012). Institutional logics shape and guide rational and mindful behavior, and individual and organizational actors have some 'hand' in changing and shaping institutional logics (Thornton and Ocasio, 2008). Contradictions that are inherent in a differentiated set of logics can provide actors (organizations, groups and individuals) with cognitive and cultural resources to transform their identities, and the larger society. Entrepreneurial actors (institutional entrepreneurs) construct explanations, narratives and vocabularies of practice to navigate established logics, create new ones and refashion or change the existing logics. Simply put, entrepreneurs try to manipulate symbols and practices to sell their ideas, with the aim that their self-interest or goal is served when the idea is institutionalized (Hardy and Maguire, 2008; Martens et al., 2007).

Another aspect of the concept of institutional logics is that logics provide a sense of self and identity by providing mutual frames of reference that shape the choices of actors for mutual sense-making and a shared vocabulary to motivate action (Meyer et al., 2013). The principles of an institutional logic differentially shape how identity is perceived (Thornton et al., 2012, p. 2). Importantly, logics provide different social identities and knowledge positions for the actors involved together with standard vocabularies to account for typical motivations, actions and decisions. The notion of social identity is important for understanding the transformation and reproduction of institutions. Identity is seen as providing the link between the micro and macro levels: between field-level meaning, institutional orders, and the sense making of individual human actors (Friedland and Alford, 1991; Glynn, 2008; Lok, 2010, 2010; Meyer and Hammerschmid, 2006; Rao et al., 2003; Thornton and Ocasio, 2008).

By using the rationale and frames of reference provided by a certain institutional logic, an individual can activate a social identity in a particular social situation. Of course, across the different social situations encountered by individuals, they activate a wide variety of social identities from different institutional logics (for example, religion or family) depending on their reference group (Meyer et al., 2013; Rao et al., 2003, 2003). Thus, a key mechanism by which institutional logics demonstrate their effects on organization space is when and how they provide and inform the identities of an industry or organizational group and shape social categorization and classification (DiMaggio, 1997).

3.4 Institutional Logics as Analytical Approach – Inter-Institutional Ideal Type System

The institutional logics perspective represents a framework for analyzing institutions, organizations and individuals in social systems (Thornton et al., 2012, p. 2). It can help researchers study how individuals and organizations are influenced by their context in an inter-institutional system. By inter-institutional system, I refer to the structuring of society along society level logics such as family, religion, state, market, professions and corporations.

Friedland and Alford (1991) introduced institutional logics and the inter-institutional system by explaining that institutions in everyday society are governed and ordered by logics, and that these society level logics (orders such as religion, family, bureaucratic state, capitalist market, democracy) are components of the inter-institutional social system (Friedland and Alford, 1991; Thornton et al., 2012). Each of these orders (or society-level logics) provides unique organizing principles, practices and symbols that influence organizational and individual behavior (Thornton et al., 2012).

In short, an institutional order is synonymous with the institutional logics that operate at the highest level of society. One implication of this is that these orders cascade down (i.e. are translated) to the lower levels of society such as the level of inter-organizational projects, organizations or individuals. I have used the term sub-logics, especially in the contributions section to describe these lower level logics. (I have only recently found that this term has been used very similarly by a couple of authors (Hayes and Rajão, 2011; Mohr and Neely, 2009; Mohr et al., 2004)). Thus, although institutional logics were conceptualized first at the societal level, more logics have been identified and explored at a variety of levels such as within industries (Haveman and Rao, 1997; Rao et al., 2003), inter-organizational (Meyer and Hammerschmid, 2006; Thornton et al., 2005) and at the organizational and individual level. Since actors are nested in these different levels—individual, organizational, inter-organizational/industrial and societal—the institutional level perspective can guide research at multiple levels (micro, meso and macro). As I will explain later in the methodology, this thesis focuses on HMIS implementation projects involving inter-organizational, organizational and individual levels. Thus, it benefits much from analysis using these conceptual assumptions from institutional logics perspective. Particularly, one of the contributions this thesis makes is exploring, in the form of an HMIS institutional logics framework, how society-level logics (institutional orders) cascade down are expressed as sub-logics in the HMIS at the lower levels of the organization or individual. Figure 3.1 below illustrates this relationship between institutional orders and sub-logics. As an example, the figure illustrates how the capitalist market institution (i.e. the institutional order or society level logic of capitalism) cascades down and is expressed as a tendency for HMIS project funders to calculate return on investment and be more interested in manageable short term projects (e.g. the “New Public Management”) rather than long-term broad system commitments.

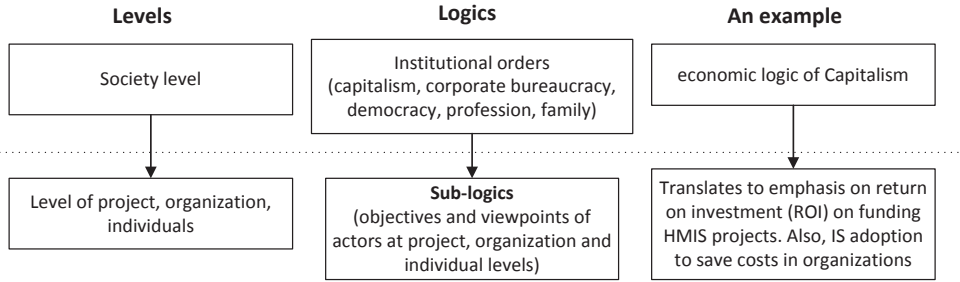


Figure 3.1. An overview of the relation between the society level logic and sub logic

Applying the Inter-institutional System – Analysis Using An Ideal Type System

A prescribed way of performing institutional analysis using institutional logics such that it incorporates its core assumptions and its inter-institutional system is by using a typology of ideal types (Thornton et al., 2012). This ideal type system approach is a well-known qualitative method that can aid structured analysis that furthers scientific inquiry (Doty and Glick, 1994, p. 244). It has been successfully used from the time of classical sociological analysis by Max Weber (Shils and Finch, 1949, p. 90) to neo-institutional theory inspired analysis (DiMaggio, 1991). An Ideal type is an abstraction from data and represent a “pure case in which the relevant features are distinct and unambiguous” Weber, 1949, p. 88). It facilitates the systematic construction of analytic categories a priori, thereby helping to guide empirical analysis, as well as helping reduce the often-unconscious observer bias in some qualitative studies (Thornton et al., 2012).

The inter-institutional system is one of the major advances of the institutional logics perspective, built as a typology of ideal types that can be useful as a theoretical and methodological tool for applying the perspective to empirical institutional analysis. Particularly, the ideal type inspired analysis has been used successfully in a couple of institutional logics based studies (Blatter, 2003; Freidson, 2001; Goodrick and Reay, 2011, 2011; Nicholls, 2010; Rao et al., 2003; Thornton and Ocasio, 2008, 1999; Thornton et al., 2005, 2005, 2012; Thornton, 2002, 2004, pp. 808–809). I will apply it to structuring my approach to research question 1, where the inter-institutional system could help in the construction of an HMIS institutional logics framework. Table 3.1 below illustrates the core inter-institutional system ideal types (adapted from Thornton, 2004. The reader is referred to that seminal piece for more extensive discussion)

Table 3.1. The core inter-institutional system ideal types (adapted from Thornton, 2004.)

Institutional orders						
	Family	Religion	State	Market	Profession	Corporation
Sources of identity	Family reputation	Association with deities	Social and economic class	Faceless, economic control	Quality of craft, Personal reputation	Bureaucratic roles
Sources of legitimacy	Unconditional loyalty	Sacredness in society	Democratic participation	Share price	Personal expertise	Market position of firm
Internal control and power mechanism	Family politics	Worship of calling	Backroom politics	Industry analysis and funding power	High status of professional	Organizational culture (e.g. bureaucratic hierarchy)
Values	Motivation of human activity	Symbolic construction of human activity	Rationalization & regulation of human activity	Accumulation & commoditization of human activity		control over human activity
Symbols, Rituals	Marriage	Communion	Voting	Signing contracts	Induction into profession	Issuance of budget and plans
Root metaphor	Family as firm	Temple as bank	Redistribution mechanism	Transactions	Relational network	Hierarchy

Tables 3.2 and 3.3 below are examples of ideal type analysis displays for two empirical domains, inspired by using the inter-institutional system. They are included here only to give the reader a better appreciation of potential products using ideal type analysis inspired by institutional logics (more details on these examples can be found in (Thornton, 2004; Thornton et al., 2005, 2012; Thornton and Ocasio, 1999).

Overall, this approach provides inspiration for the HMIS institutional logics framework I will display later in the contributions section. I will aim to extract some of the ideal types in HMIS using the core institutional logics of state, market, profession and corporation.

Table 3.2 Ideal types of institutional logics in architecture (Thornton et al., 2005) – an example of ideal type analysis (included just to give the reader an instance of institutional logics ideal type analysis)

Characteristic	Aesthetic logic – sublogic of (artistic) professional logic	Efficiency logic - sublogic of (managerial) professional logic
Economic system	Personal capitalism	Managerial capitalism
Sources of identity	Architect as artist–entrepreneur	Architect as engineer–manager
Sources of legitimacy	Reputation of architect Aesthetics of design	Scale and scope of firm Efficiency and economics of design
Sources of authority	Design prowess	Managing partner or supervisor
Basis of mission	Build personal reputation, Build prestige of firm	Build multidisciplinary firm Build market position of firm
Basis of attention	Resolve design problems and entrepreneurial challenges	Resolve technological and organizational challenges
Basis of strategy	Increase prestige of patron or government sponsor. Win design competitions	Increase number of corporate clients, Build recurring clientele Increase markets for services
Logic of investment	Build wealth and prestige of entrepreneurs	Build wealth of partners
Governance mechanism	Entrepreneurial firm Profession	Partnership ownership Private global multidisciplinary corporation

Table 3.3 Ideal types of institutional logics in higher-education publishing (Thornton, 2004; Thornton and Ocasio, 1999) – an example of ideal type analysis (included just to give the reader an instance of institutional logics ideal type analysis).

Characteristic	Editorial logic - sublogic of the professional logic	Publishing market logic - sublogic of economic (market) logic
Economic system	Personal capitalism	Market capitalism
Sources of identity	Publishing as profession	Publishing as business
Sources of legitimacy	Personal reputation Education value	Market position of firm Share value
Sources of authority	Founder-editor Personal networks Private ownership	CEO Corporate hierarchy Public ownership
Basis of mission	Build prestige of house, Increase sales	Build competitive position of corporation Increase profits
Basis of attention	Author-editor networks	Resource competition
Basis of strategy	Organic growth Build personal imprints	Acquisition growth Build market channels
Logic of investment	Capital committed to firm	Capital committed to market return
Governance mechanism	Family ownership Trade association	Market for corporate control

In sum, I have so far described the analytical framework I will apply to answering research question 1, which is focused on how institutional logics and their interplay influence and shape the HMIS implementation process. For the second research question, which borders on analyzing HMIS implementation complexity, I have attempted to synthesize an institutional logics inspired complexity framework using the perspective of institutional logics. This I attend to in the following subsection.

3.5 Conceptualizing Institutional Complexity – Institutional Logics perspective to Complexity

Returning to the second specific problem of concern (research question 2), HMIS implementation complexity, this subsection explores how institutional logics can help us understand HMIS implementation complexity better and how it may help point to the sources and aspects of complexity. Complexity has been a heavily debated concept in both IS and organizational research. It is a broad topic, so here I focus on only aspects related to an institutional logics perspective.

Within the institutional perspective, complexity appears to be a newly imported concept, touched on only recently (Greenwood et al., 2010, 2011; Kodeih and Greenwood, 2012). As Daudigeos et al. (2013) contend, the institutional logics literature has so far downplayed and ignored the important topic of institutional complexity.

By institutional complexity, I refer to the challenge with managing large multi-participant inter-organizational implementation project. This is especially so in light of the sheer large number of logics (multiplicity), diversity of logics (heterogeneity) and conflict between the logics (implementation tensions), as well as historical embeddedness, potential power struggles and the complexity of the composite identity. This is a view to complexity I am proposing in this thesis, and the paragraphs that follow help explain the six aspects - multiplicity, heterogeneity, conflicting logics, historical embeddedness, complex identity and power arrangements (sometimes borrowing from views on complexity in the extant literature).

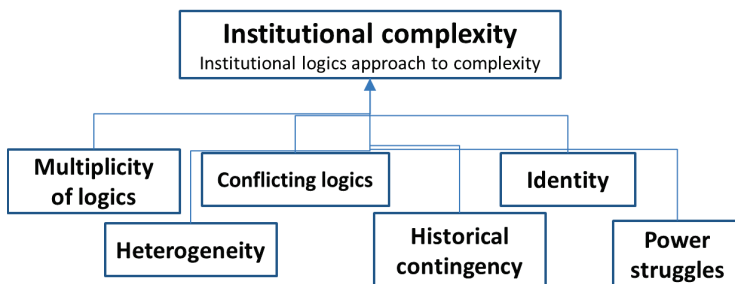


Figure 3.2. An illustration of this thesis’ proposed view of institutional complexity, inspired by institutional logics perspective.

3.5.1 Multiplicity of Logics

According to the Webster English dictionary, multiplicity simply means “the quality or state of being multiple or various.” Multiplicity captures an important aspect of complexity of contemporary society (Grisot, 2008). The more numerous the logics at work within a field is, the higher the complexity to be managed by social actors participating in the field (Daudigeos et al., 2013). Thus, complexity partly stems in part from the sheer number of logics involved in a given field.

The idea of multiplicity has already proven useful to the study of IS in healthcare (Grisot, 2008; Timmermans and Berg, 1997). HMIS researchers in developing countries have hinted at the importance of multiplicity even though not explicitly sometimes. For example, Kanjo (2011) highlights that HMIS design and implementation takes place in many different but simultaneous environments and these environments have a multiplicity of knowledge and belief systems. The existence of these belief systems and multiple realities is evidenced by different health sectors, service providers, programs and information systems (Mosse, 2004; Sahay et al., 2009), and even different policies Kanjo (2011). Typically, individuals (managers and health workers) working within the multiple levels of the health system have different codified cultural social routines and rules. Understanding these multiple rules and routines, and how they play out may provide insights into understanding the complexity associated with implementation challenges (Kimaro and Sahay, 2007). The sheer multiplicity of logics potentially can overwhelm the cognitive capacity of coordinating actors such as project managers. Yet, the multiplicity of logics may provide alternatives in meanings and allow for deviance for individuals and organizations, and provide opportunities for innovation. In sum, such multiplicity of choices presents

elements of unpredictability for institutional actors, e.g. participants in an HMIS implementation process.

3.5.2 Heterogeneity of Actors and Multi-Level Nature of Logics

Many implementations of HMIS, because of their large scale, are heterogeneous as they have different and diverse social and technical components including varying norms, routines and changing requirements. Since there is a multiplicity of logics, and logics drive actors' goals, there is a tendency for heterogeneous settings to feature a multiplicity of goals. Complexity emerges when logics of different kinds exert influences simultaneously, requiring them to be constantly negotiated and contested in a quagmire of actors.

More so, this happens at many levels, further increasing the complexity. The multiple levels of a typical large health system are composed of many different institutions, each with their own main logic, and symbolic constructions that form the organizing principles that organizations and individuals draw upon to identify their position as well as resolve contradictions (Friedland and Alford, 1991; Kimaro, 2006). The heterogeneity of the HMIS necessitate that multiple contexts be taken into consideration (Braa et al., 2004). I believe that this is important approach that institutional logics helps bring in to better understand institutional change, considering that neo-institutional theory seems to focus on homogeneity (isomorphism) and is weak at explaining heterogeneity.

3.5.3 Identity and Logics

Logics guide action and are tied to identity (March and Olsen, 1984). Like legitimacy, identity is an important element in institutional logics (Thornton et al., 2012). The relationship between institutional logics and identity is recursive—each shapes the other. This is because institutional logics give identity to those who share them, and those who share identity mutually reinforce their shared logics. Greenwood and Hinings (1988) and Kraatz and Block (2008) show that identity is useful for understanding complexity, especially in relation to the multiplicity of logics. This is because multiple logics can lead to “variegated individual and organizational identities” (Thornton et al., 2012, p. 180). These authors point to the need for more research into the complexity of identity. Also it is possible for identities to blend into a hybrid identity. As different institutional logics often entail dissimilar social identities with diverging positions, we can expect struggles over the legitimacy of a new orientation to take place while the processes in which the prevalent institutional logics are challenged or changed are contested. (Lok, 2010, p. 1307). Identity is essentially the micro-level enactment of social structure. It is not a permanent or stable core of a person or group but rather, is situationally modified and adapted. An individual may have multiple “different social selves as there are distinct groups of persons about whose opinions he cares” or considers (James, 1968, p. 42). Competing or conflicting institutional logics may be associated with various individual actors who take their identity from different logics and position them against those from other actors. To the degree that social identities are dependent (Hall and Du Gay, 1996, p. 6), the actor is able to assume multiple different identities and may be able to shift among them throughout the course of an interaction (Harrison and Davis, 2001).

Moreover, complexity increases because individual actors can draw on differing logics at the same time, such that—even if temporarily, while the tussle is ongoing—they give rise to cross-bred versions of

identities that are different from either of the constituent competing identities and logics (Cooper et al., 1996; Rao et al., 2003).

3.5.4 Historical Contingency

Another way of looking at the complexity of institutional change may be to look at the historical contingency (i.e., the linkage between institutions and their past). Organizations are historically embedded (Zucker, 1991). When implemented in an organizational context, information systems have externalities and develop inertia over time and this makes them hard to modify, design (or redesign), and extend in any major way (Rolland, 2002). Many studies of large-scale information systems across various institutional settings show that these systems tend to be notoriously difficult to change due to the inertia and historical resistance of an installed base of existing technologies (Hanseth and Monteiro, 1998; Monteiro and Hanseth, 1996). Historical contingency is a major meta-theoretical assumption of the institutional logics approach (Thornton and Ocasio, 2008). In general, logics develop inertia and become hard to change.

3.5.5 Conflicting Logics

Perhaps an even more obvious source of and well-discussed aspect of complexity involves conflicting logics. With a multiplicity of logics, there is a risk of inconsistencies and incompatibility. The institutional forces of a multi-participant organizational space are often contradictory (Avgerou, 2002). The higher the degree of inconsistency, the greater is the complexity with which actors in the field need to deal (Daudigeos et al., 2013). Different influencing organizations (international, national, local) may exert conflicting pressures on the organization to adopt their own perspectives, values and models. Scott (2001) argues that the presence of conflicting or contradictory rules creates room for individual discretion, strategic behavior and choice.

Institutions can create contradictions among groups within organizations because of divergent or different practices and beliefs undermining the permanence of each, which can afford the impetus for change (Scott, 2001). For instance, the mere existence of various levels within the health system administration, each with their different institutional influences, often occasions contradictions (Gutierrez and Friedman, 2005; Jepperson, 1991). Gutierrez and Friedman (2005) explain that HMIS project goals and expectations often expose contradictions in the different institutional logics. They argue that HMIS implementation design and planning efforts represent a natural source of contradiction and often involve incompatible perspectives and logics.

Similarly, Currie and Guah (2007), on investigating the HMIS in the United Kingdom, describe healthcare as

“infused with institutional logics emanating from various sectors across the field. Healthcare is politically contentious where societal level logics created by government are embodied in policies and procedures that cascade down from the environment to organizations. Various stakeholders including clinicians, managers, administrators and patients interpret and re-interpret these logics according to the degree to which they affect changes to the perceived or real material resource environment of the institutional actors”. (p 237)

Currie and Guah (2007) further argue that one of the significant challenges facing HMIS implementation is “to reconcile competing institutional logics.” (p245)

Similarly, Avgerou (2004) articulates, in her analysis of an HMIS implementation in Jordan, that the HMIS project had to satisfy two lines of authority with divergent logics—the local bureaucratic structures of the health services and the USAID (United States Agency for International Development) mission—whose fundamental values and principles about development and organizing were in conflict. She describes that they clashed on many issues:

“Initially, the USAID mission, consistent with its general policy of promoting administrative decentralization, favored a system to address the planning requirements of the 12 governorates (regions) of the country, excluding the central decision makers from the system’s reporting flows. This created friction with the Ministry of Health (MoH), in effect attempting to circumvent technically the current power structures (at the ministry). Second, from the initial conception of the project, the USAID mission wished to focus exclusively on improving the quality of reproductive health services, which is another area of concern and policy for this development agency, (to which the ministry was strongly in disagreement). The aid recipient negotiators of the Ministry of Health shifted the emphasis of the project to primary health care (PHC) instead. Nevertheless, after analysis specifications were drawn and the first prototypes built, a new USAID mission director raised the family planning issue again and asked for the specifications to be changed” (p58)

Avgerou (2004), thus, highlighted two conflicts: one between the logics of decentralization and centralized control; and another involving the scope of intervention between a ‘vertical’ focus on reproductive health (by USAID) and a horizontal broad focus on primary health care (by the ministry).

Bernardi and De Chiara (2011), in their analysis of the Kenyan HMIS implementation also describe a tension between two major logics: the ‘New Public Management’ (Hood, 1991) embedded in imported health reform models (and leaning towards a focus on a result and performance-oriented approach) and the “Old Public Administration” (De Araujo, 2001) of traditional African bureaucracies (with their characteristic central political control and strong hierarchies).

Scott (1995) argues that the presence of conflicting or contradictory rules creates room for uncertainty within the presented range of choices and behaviors. Particularly, an emerging body of literature characterizes this situation as that of competing or conflicting institutional logics: a situation where decisions and actions in the implementation process are contested by the different (and sometimes divergent) rationalities or belief systems of the different actors involved (Pache and Santos, 2010; Reay and Hinings, 2009; Thornton and Ocasio, 2008).

Recognizing the central role that conflicting logics play in the implementation process, researchers have emphasized the need to understand how to resolve such conflicts. The current understanding is that the resolution of such conflicts usually takes place through a change management process involving

deinstitutionalization of one logic and the institutionalization of another (Dacin et al., 2002, 2008; Oliver, 1992; Sahay et al., 2010; Scott, 2005). Deinstitutionalization refers to the process by which institutional logics erode and disappear (Dacin et al., 2008).

Sahay et al. (2010) apply this to describing their work in deinstitutionalizing the logic of paper-based data collection and the institutionalization of a computer-based (electronic processing) logic. However, I argue that conflict resolution in change management processes can also occur without deinstitutionalization or the extermination of one logic. This is discussed further in the contribution section where I prose and explain the alternative possibilities of changeover (transitional) and dialectical resolution. However, to summarize, I use changeover resolution to describe the situation where participants reach a compromise and then move the project from one dominant logic to another, in other words, changing over dominant logics, yet acknowledging the weakened logic, which becomes recessive but can later be operationalized. Meanwhile, I use dialectical resolution to refer to the situation where conflicting logics are resolved through an approach that synthesizes the competing logics into one solution, rather than exterminating one for the other. Here, I adapt the concept of Hegelian dialectics as applied to organizational change, i.e., that organizational change occurs through tensions and contradictions, resolved through a synthesis of competing logics (Farjoun, 2002; Mumby, 2005; Nordheim, 2009; Olivos, 2004; Seo and Creed, 2002; Van de Ven and Poole, 1995). In sum, conflicting logics can be resolved through deinstitutionalization, changeover resolution or dialectical resolution. The choice of one depends on the logics involved. Thus, it is important that conflicting logics are identified and understood within projects. However, within HMIS research, there remains a large gap in understanding and identifying institutional logics and the conflicts that may occur between them (Sahay et al., 2010). This study contributes to filling this gap.

3.5.6 Power

The topic of power is a broad one, and the aim here in this short subsection is not to do justice to such a wide topic. Rather, I hope to be able to hint at the relevance of considering power arrangements when analyzing HMIS implementation complexity, especially from an institutional logics perspective.

From the preceding subsection, it can be seen that conflicting logics can produce power struggles.

Participants that mobilize around conflicting logics in effect become engaged in a power struggle, with the opposing logics acting as a proxy.

A classic case in the institutional logics literature is that of a conflict in the banking industry between the community logic (community banks) and the corporate capitalist logic (corporate banks) (Marquis and Lounsbury, 2007). Marquis and Lounsbury demonstrate how the community logic permitted and brought together aggrieved banking professionals, to oppose the imposition of corporate logics by exiting banks (targeted for hostile takeovers by large corporate banks), to go on and form their own local community oriented banks. In addition, Townley (1997) has shown how the presence of a professional logic allowed academics to fight back, with success, the forced application of performance appraisal practices linked to bureaucratic and economic logics – revealing the underlying power struggle between the logics.

In essence, what these point to is that understanding the underlying logics, and conflicts between them can expose a usually hidden aspects of power struggles. This institutional logics-based approach has not been explored in analyzing power struggles in the HMIS, but is a useful perspective to unearth possible

power struggles in HMIS implementation. Having said this, the intention is not to shelve or ignore the other approaches to studying power in HMIS as in numerous preceding studies (Ash et al., 2007; DiPalma, 2004; Gladwin et al., 2003; Nyella and Mndeme, 2010). Instead, I aim to explore my empirical material in a different way to contribute to a better understanding of aspects of HMIS implementation complexity.

3.6 Summary - Research Gaps

In reviewing the literature, we see that prior research on institutional logics in developing country settings has been limited, especially within the HMIS domain. In addition, there are many areas to which authors suggest that future research studies should pay more attention. Scott (2005, p. 478) points out that in the institutional literature “an embarrassingly large proportion of our theoretical conceptions and empirical findings has been constructed by U.S. scholars based on data collected from U.S. organizations.” While this has improved for the general institutional literature, the scantiness is still true for institutional logics literature.

Only recently has institutional logics been applied in low resources settings (Bernardi and De Chiara, 2011; Hayes and Rajão, 2011; Nicholson and Aman, 2012; Sahay et al., 2010), and this scanty literature points to the need for a rich empirical exploration of this area, which a couple of authors have also pointed to (Thornton and Ocasio, 2008; Thornton et al., 2012). This is even truer within the subset literature of HMIS in developing countries where, with the exception of a few short papers that suggest the utility of an institutional logics perspective (Sahay et al., 2010), there are limited empirical studies that explore the institutional logics of HMIS. From my review of literature, there has been to date, no application of the inter-institutional system to analyze the HMIS, and. By contributing this important instantiation of the core assumptions of institutional logics within the HMIS domain, I hope to derive new knowledge in the form of a broad institutional framework that advances our knowledge of HMIS implementation.

The literature review also showed that work on institutional complexity has been scanty. In addition, work from Thornton et al. (2012) and Greenwood et al. (2011), as well as my discussion in this chapter, illustrate that we are only beginning to scratch the surface of what institutional complexity is. In this chapter, I proposed, from a synthesis of existing literature and some conjecturing, a six-prong analytical framework for exploring institutional complexity. My hope is that this can be a contribution to this under-researched body of literature. One aspect of institutional complexity on which more insight is needed is in understanding conflicting logics and resolution strategies.

In sum, this thesis aims not just to contribute to these theoretical discussions but also to ground its contribution within the context of the practical problem of the complexity of HMIS implementation. It is in the context that the research questions were framed, focusing on deriving frameworks to help us understand HMIS institutional logics, institutional complexity and Implementation tensions and resolving them. These three main contribution areas form the bulk of discussion in the chapters on contributions and practical implications. The contributions are relevant for understanding and providing insights into managing the complexity.

I conclude by summarizing with an illustration (table 3.4 below) that gives an overview on how this research will apply the institutional logics to the three research questions i.e. how the perspective will translate to analysis.

Table 3.4 Overview of research questions, theoretical approach and resulting contribution.

Research question	Theoretical approach	Product (Contribution)
RQ1	Apply inter-institutional framework of ideal types	HMIS institutional logics framework
RQ2	Apply the institutional complexity framework I synthesized in this chapter	HMIS institutional complexity framework
RQ3	Conceptualize approaches to resolving HMIS conflicting logics	HMIS tensions resolution framework

CHAPTER 4: METHODOLOGY

In the two preceding chapters, the empirical framework (chapter 2) and the theoretical framework (chapter 3) have been discussed. This chapter outlines the research design and the methodology utilized in this thesis. It begins by highlighting the research setting and its appropriateness to the research question, and then justifies the approach to the research question. It then describes the research design (action research), my involvement and fieldwork as well as the data collection and analysis. Particularly, in the analysis subsection, I link up previous discussions from the conceptual framework chapter, where I discuss how institutional logics perspective will guide the analysis.

The chapter concludes by reflecting on my research approach and its challenges. Particularly, in describing the approach based on canonical action research (CAR), I also point out how I followed CAR principles, as well as where I deviated, highlighting some critiques of 'pure' CAR.

4.1 Research setting, aim and justification

The context for this study, as has been elaborated in chapter 2 (empirical context), is the Nigerian HMIS, with all its historical, sociopolitical and health sector antecedents. It was emphasized that the research is set in the country's vision and efforts at having a robust and comprehensive HMIS that serves as a backbone for evidence-based health system reform. Specifically, access to study the phenomena was gained through two projects (PRRINN and NEHSI) that exemplify the efforts at developing and implementing the national HMIS. The research aim that has guided the research involves finding how we can understand the institutional logics and institutional complexity of HMIS implementation in Nigeria.

The choice of the setting is an appropriate one for the research aim, and is justified by being grounded in 'real world' HMIS projects occurring in low resource settings and involving rich multi-participant contexts. The Nigerian context provides ample ground to study the complexity of HMIS implementations in low resource contexts with the involvement of multiple institutional actors.

4.2 Approach to Research Question: Justifying An Interpretive, Qualitative, and Action-Oriented Approach

Having an appropriate setting for the research question is but one aspect of the research design, the research approach also needs to fit the research question, which in this case concerns exploring the institutional logics and complexity of HMIS implementation. Several authors (Morgan and Smircich, 1980; Susman and Evered, 1978; Symon and Cassel, 1998) have suggested that qualitative research would be beneficial for investigating complexities, processes and the little known dynamics in organizations. Accordingly, an interpretive qualitative approach would be a good fit for this study's interest in investigating the perspectives and experiences of HMIS implementation. Such a research direction requires a socially conscious approach that engages with real world HMIS organizational contexts and the multiple actors involved as well as their different interests and logics. My approach thus incorporates the understanding that HMIS are artifacts made by people to meet people goals and do not exist independent of subjective human involvement - and so cannot purely be assessed objectively (Susman and Evered, 1978). Organizations are made up of people that need to be felt and understood (Holloway and Wheeler, 2002) and these organizational actors can "collaborate in the diagnosis of their own problems and in the generation of knowledge" (Susman and Evered, 1978, p. 586). In addition, this study is based on the assumption that diagnosing and analyzing problems is not adequate; and an action-oriented perspective is needed to be embedded in, and in working towards finding methods to tackle real world concerns (Lewin, 1946).

I have thus adopted a research approach that is both interpretive and action-oriented to offer deep insights towards improving understanding as well as focus on tackling the problems associated with the

institutional complexity of the HMIS. Thus, I have followed the line of action-oriented social inquiry pioneered by Lewin (1946) which combines the formulation of concepts with the intervention process of changing the social system (or organization), through the investigator acting on and in the social system. Thus, I consider myself a means of both changing the system as well as generating critical knowledge about it, as in (Lewin, 1946). Towards achieving this, my approach has been collaborative; implying participatory HMIS implementation through the cycles of problem diagnosis, action planning, action taking, evaluation and reflection, as described by Susman and Evered (1978).

In using this approach, I also have drawn from Walsham (1995) who argues that the “separation of subject and object” in IS research denies the wholeness of being and acting in the world - reality is collaboratively produced by the actors involved and the context in which it occurs. The researcher is an actor as well as a party to building such reality (Klein and Myers, 1999; Walsham, 1993, 1995).

I have particularly favored this approach to understand the ‘whole’; striving for being embedded in the HMIS implementation context, especially since this research has aimed to explore contextual meanings. In sum, I have subscribed to an epistemology that involves interpretive understanding through hermeneutics (Gadamer, 1976). Hermeneutics refers to the iterative process of understanding the complex whole from the perceptions and conceptions about the meanings of the parts and their interrelationships (Geertz, 1973). Interpretive research aims to understand phenomena through the meanings and values people assign to them (Orlikowski and Baroudi, 1991). My process of deriving understanding was thus not based on a linear procedure, or based on predefined formula or dependent and independent variables. Instead, understanding was generated through interpretation, in a way that was conversational, dialogical and iterative. Thus, I expect that some of my findings may appear subjective and open to multiple interpretations, as most interpretive research is (Walsham, 1993). In summary, this thesis is based on an interpretive epistemology involving a qualitative approach to data gathering and analysis; while situated within a broad action research methodology.

4.3 Application of Action Research in This Study

Action research is a research methodology that aims to generate new knowledge through taking part in cycles of action, reflection and learning and has been used as a research approach in IS research since the early 1980’s (Baskerville and Wood-Harper, 1996; Wood-Harper, 1985). It is valuable in providing a mechanism for understanding complex social events in the real world and permits the analysis of multiple networks “in which it is very difficult to analyze cause and effect” (Wood-Harper, 1985, p. 180) considered an exemplar approach for exploring institutional issues (DeLuca et al., 2008). Baskerville and Wood-Harper (1998) outline and identify many streams of action research including canonical action research, action science, soft systems, participant observation, information systems prototyping, action learning, ETHICS, multiview, process consultation and clinical field work. Other forms of action research include collaborative practice (Mathiassen, 2002), reflective systems development (Mathiassen, 1998) and network of action (Braa et al., 2004).

Of all these, two strains of action research - canonical action research (CAR) and network of action - were particularly relevant to my research design: CAR is a useful guide for any AR, while network of action, as I explain shortly, is a useful approach for research that is part of a large distributed program of research. However, I regard CAR somewhat as an ideal type or model that can be modified to suit a particular setting, rather than applied in the purist sense. Thus, my use of CAR is not without some critique of its purist and sometimes-unrealistic tendencies, which tend to suit ordered and controlled environments. My critiques are based on the ‘messiness’ of the reality of the projects I was involved in, and they are discussed in the following paragraphs as I discuss the principles of CAR.

4.3.1 Implementing Canonical Action Research

Canonical action research or 'CAR' (Davison et al., 2004) is an important methodology used to impose rigor and relevance on action research; thereby providing strong validation for a method that had been struggling for acceptance in past decades. CAR was adopted because it provided me the core principles of performing methodologically rigorous action research in a low resource context shaped by multiple institutional actors.

Specifically, CAR has laid down five widely accepted tenets (Davison et al., 2004) that action researchers should follow: the Principle of the Researcher–Client Agreement (RCA); the Principle of the Cyclical Process Model (CPM); Principle of Theory; the Principle of Change through Action; and the Principle of Learning through Reflection. I now discuss how I followed these principles in this research:

1. The Researcher–Client Agreement (RCA) Principle. This is an agreement that helps to foster a spirit of shared inquiry by having clients contribute to the process of research as the researcher collaboratively assesses the problems, determines actions, implements changes and evaluates the outcomes of those changes (Davison et al., 2004). I have been fortunate as a PhD student to become embedded within already established research projects with existing collaborative agreements and networks. The clients in both of my cases involved non-governmental and donor-funded organizations, which had agreements with the Ministry of health about the research process and their participation in the cycles of change through diagnosis, action and learning. Unlike most CAR client cases though, the client in my case was not a single person or organization but a complex mix of organizations. For example in the PRRINN project, which is a development research program, I was contracted by an NGO to work with the HMIS department of the Ministry of Health, which was distributed across 4 Northern states but I worked mostly within the districts and health facilities. Similarly, in the NEHSI project, I was contracted by the partnership between the research organizations (the IDRC and the Universities of Calabar and Maine), who were collaborating with the ministry of health and the selected district and communities. It is even more complex because the districts and the health facilities are not organized under the ministry of health, but under respective semi-autonomous democratically elected local governments, so the local governments were also involved as clients. This multi-client complex is what partly makes HMIS implementation a complex process, and makes a reductionist approach to the client structure unreliable. I see this more as a complex inter-organizational field, where all the actors are focused on improving the HMIS, and the HMIS institution becomes a unifying 'client' for all the partners.

In addition, we did not discuss theories in the 'academic' sense. Rather, because of the non-theoretical and pragmatic context in which the fieldwork was done, we have only used relevant core concepts involved in this thesis such as institutionalization, sustainability, and institutional logics. In this light, a critique of ideal type CAR may be that not all members of the client complex may be able to understand fully the theoretical or conceptual aspects as they are often focused on the immediate pragmatic concerns of solving the empirical problem.

2. The Cyclical Process Model (CPM) Principle, which mandates a cycle or a spiral (of few cycles) through which the intervention moves ever closer to the pith of the organizational problem with each iteration (Davison et al., 2004). Action research has been applied to this research using the five CAR cycles of problem diagnosis, action planning, action taking (intervention), evaluation and reflection (see Figure 4.1 below). In this case though, the cycles were not determined beforehand; rather, they evolved and emerged cycle after cycle, as it was uncertain what the next issues were going to be, or if there would be continued funding for the work. Each phase was decided based on problems and opportunities in the preceding phase. However, far from being a perfect CAR project, in this research, the implementation and decision-making hinged on the availability of funding, which was intermittent and weak – this in itself characteristic of low resource settings. Thus, planning was piecemeal and the cycles were sometimes concurrent (and sometimes even disrupted), rather than following a carefully

thought-out clean CAR ‘grand scheme’. In the PRRINN project, there were four overlapping implementation phases. These phases (also in Table 4.1 below) include: the establishment of a sentinel system and introducing a computer-based HMIS; strengthening the State HMIS and piloting the mHealth technology; stabilizing/institutionalizing the mHealth technology by hosting internally at the Ministry of Health; and finally, migration to Internet-based DHIS2 with remote access through mobile modems. In the NEHSI project, they were 3 cycles (see table 4.2)

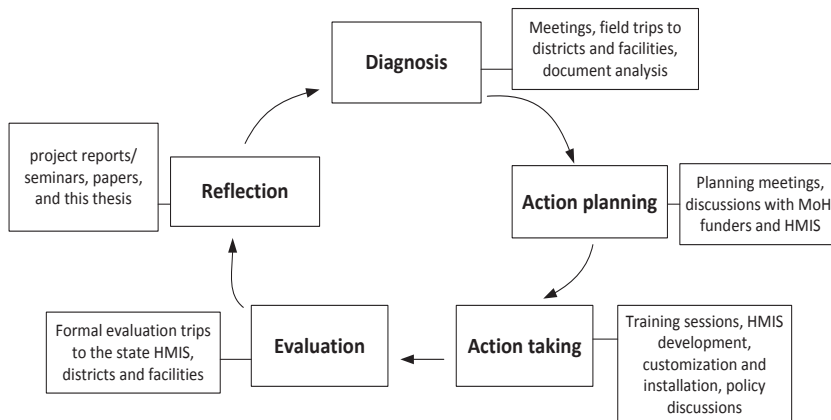


Figure 4.1. Components of an action research cycle (Susman and Evered, 1978)

Table 4.1. Four action research cycles carried out in PRRINN (see more in paper 3)

Table 4.2 Three action research cycles in the NEHSI project

Cycle 1 (2008) - Establishment of sentinels; introducing computer-based HMIS
Cycle 2 (Aug 2009- Oct 2010)- Strengthening the State HMIS and introducing mobile technology
Cycle 3 - Stabilizing/institutionalizing the mobile technology by hosting internally at the MoH
Cycle 4 (2011-2013) - Migration to the Internet with remote access through mobile modems

Cycle 1 (2010) - Setting up the Paper-based system
Cycle 2 (2011) - Migration to a hybrid (mobile and paper based system)
Cycle 3 (2012) - Establishment of a paperless mobile data collection system

3. Principle of Theory;

There is ongoing debate about the obligatory use of theory to guide the stages of CAR. McKay and Marshall (2001) contend that action research without theory is not really research, arguing that a distinctly formulated theoretical framework must always be enforced on the phenomenon of interest. Others (Bunning, 1995; Cunningham, 1993; McTaggart, 1991) Cunningham 1993, p. 61) differ, arguing that the practical application of theory, especially at the very start of a project, can be counter-productive. Particularly, Cunningham (1993) admonishes that it is highly improbable that the investigator can know the precise theory that will be most appropriate in advance, especially when an interpretive or hermeneutic process is used. I take my stand with Cunningham in this debate, and agree with the seminal CAR authors (Davison et al., 2004) who argue “a CAR project may begin with theory-free action learning” (p 74).

At the start of my research, I thought I was confident about the use of complex adaptive systems theory to understand social aspects of implementation complexity. However, as the research proceeded, I switched to the institutional perspective. Just as Cunningham (1993) asserts, it can be difficult to be sure at the start – especially considering the fact that the hermeneutic process involves cycles of going

back and forth between data and concepts. I therefore continued my research by exploring and testing concepts and theories that were most appropriate. Thus, the initial stages were relatively theory free, but the study got theoretically richer as it continued, an approach that Davison et al. (2004) argue is compatible with rigorous CAR.

I would like to explain further the re-posturing in my theoretical stance during my research. As my empirical fieldwork progressed after my first year, I was overwhelmed albeit inspired by the complexity of HMIS implementation, so I decided to explore this using complexity theory. The predominant complexity theory I found was the Complex Adaptive Systems (CAS) theory (ref), and this I decided to investigate. However, as I explored CAS further and deeper, and even trying to apply it (albeit unsuccessfully) to explain the complex organizational setting I met on the field, I found its vocabulary not rich enough to explain some of the conflicts I found in the social fabric of the HMIS implementation. Some of the critiques of CAS became obvious to me such as its lack of sociological constructs such as agency, power, social relationships and hierarchy, among others. It appears that this may be linked to its origins from the more physical sciences such as physics, mathematics and biology. For me one of the failures of CAS I encounter was that much of the CAS literature discussed truly adaptive systems such as the anthill, weather patterns, etc. that seemed to work in emergent coordination without any overall broad ordering or structure. Whereas in the system I worked in, things did not appear adaptive and the institutional arrangements seemed to be structured and ordered, with rules and scripts written for the overall functioning of the organizational systems. If organizational work was not done, things collapsed, and became disorderly; order unlikely to emerge de novo.

These to me represented a difference between the physical world where CAS had arisen and been useful more successfully, and on the other hand, the world of social reality, where power arrangements and legitimacy played a role.

I therefore sought after sociological perspectives from which I could explore the analysis I was interested in. Institutional theory and in particular institutional logics, as core sociological constructs, provided rich constructs that suited my needs. Particularly, I was interested in using one broad framework rather than become involved in a sea of concepts, and this institutional framework helped me achieve this parsimony.

Thus, truly, as Cunningham (1993) asserts, theorizing in an action research program (or any hermeneutic process for that matter) may involve some process of finding the right vocabulary and conceptual lens to achieve the analysis of data from the field.

4. The Principle of Change through Action

According to Davidson, AR's essence is to implement action so as to change the current situation and its unsatisfactory conditions (Davison et al., 2012; Eden and Huxham, 1996). This fourth principle reflects the essence and indivisibility of change and action; with intervention seeking to produce change as well as foster understanding. I was fortunate to be involved in projects where the client and I had a shared understanding of the organizational situation and its challenges. We both owned the problem, and with motivation to improve the existing situation, we were able, opportunely, to effect changes – chiefly, improvements in how HMIS data was captured and handled. Witnessing the transformation was also humbling: When I first arrived at the respective states, there had been no DHIS installed or HMIS software, and by the time I left there was extensive use of the DHIS with many members of staff trained to sustain the work. I contributed at different levels – both towards improving personal capacities, as well as towards increasing organizational capacity, efficiency and knowledge.

5. Principle of Learning through Reflection

Lau (1999) in (Davison et al., 2004) asserts that the explicit specification of learning is a most critical activity in action research. The motivation for this principle (learning through reflection) arises from the manifold responsibilities of the action researcher: to the client and to the project on one hand, and to the research community on the other (Davison et al., 2004). In this research, this was achieved through numerous seminars I participated in and reports I authored (and co-authored) for the organizations I worked with, as well as the academic papers I published (as detailed in the preceding chapter). This thesis is in itself a culmination of this learning through reflection. It is also important to mention that I found it useful to be able to 'retreat' from the field, often, to reflect on my collected data, and then go back again for more data; essentially an intermittent fieldwork approach permitting a hermeneutic process involving alternating periods of reflection and fieldwork. I really treasured the periods of reflection as they help me achieve some 'analytic distance' from the action. In essence, it helped me avoid getting over-involved in the 'action' (and consulting) as is common in action research (Baskerville and Wood-Harper, 1996).

4.3.2 Network of Action

Apart from canonical action research, this research was influenced by the 'network of action' thread of action research methodology (Braa et al., 2004). I view the network of action not as an explicit action research method in competition with CAR, but rather a complement, particularly as a way of organizing large-scale distributed action research in a sustainable way. The approach is based on the principle of creating learning and innovation through multiple sites of action and use, and sharing these experiences across sites (Braa et al., 2004). It proffers a network solution to the sustainability challenge through enhancing the maintenance of learning across action research endeavors in low resource settings. This network solution involves engaging stakeholders in multiple nodes all within a long-term period through participatory action. I identify three levels of networked research in my study; (1) the international HISP network, (2) the national (Nigerian) HISP team and (3) the national HMIS network of sites (national, states and districts) with which I was personally involved in, but partially nested in and linked with the aforementioned (1 and 2) through me.

The international HISP network is a global development and research network on health information systems led by the University of Oslo. It began in South Africa in 1994 based on work focused on building information systems for districts in apartheid South Africa, but has now grown to a global network with organizations and participants in over 15 countries in Africa and Asia. In general, HISP aims to support national, state and district health management information systems and decentralization structures in developing countries and much of its work involves HMIS design and implementation. I have been involved in the Mobi-health research network, a subunit of the international HISP network and an interdisciplinary project within the HMIS and mHealth domains that aims to create new knowledge about the development and use of mobile technology in low resource settings. In particular, it focuses on the creation of sustainable HMIS for primary health care workers at the lowest levels

Key nodes within this network relevant to this research include the University of Oslo HISP node, HISP India, HISP South Africa and HISP Nigeria. In Nigeria, HISP (HISP Nigeria) was initiated through the partnership and guidance of the HISP South Africa team, who started the first DHIS implementation in Nigeria. The Nigerian HMIS adopted the DHIS as national software and the Nigerian HISP team has been involved with implementation and scaling. There are other researchers and research sites under HISP Nigeria and University of Oslo HISP. So my research settings were among many nodes in a broad research network, through which learning and insights were exchanged.

This research draws on my engagement with the design of the Nigerian National HMIS (NHMIS), both in the role of a member of the HISP team and as a reflective researcher involved in multiple sites of the national HMIS. I was able to triangulate learning between the sites of action I was personally involved in.

4.4 My involvement, role and fieldwork

I was opportune to gain good access for this study, mainly through active engagement in the thick of HMIS implementation activities in the PRRINN and NEHSI projects. The donor-led nature of major HMIS projects in Nigeria meant that accessing the phenomena of interest required deep involvement in these projects funded by international NGOs.

The first site of action I was involved in was the PRRINN Project situated in the fragile socio-political setting in Northern Nigeria. The conflicts in the region and challenges of continuous access to the site were an issue in the later phases of the project. Auspiciously, as my access and work on that project (and the associated access to fieldwork) was reducing in Northern Nigeria, I got involved in designing and implementing the NHMIS and mHealth data collection in another state, Cross River state, under the NEHSI project.

Altogether, I made forty-two (42) field trips (32 in the PRRINN project and 10 in the NEHSI project) between March 2008 and February 2013 (Please see table 4.3a and 4.3b for more details). Summed together, this totals over 383 days (275 days in PRRINN and 108 days in NEHSI) of physical presence and full immersion in HMIS related work. Beyond physical presence and immersion, I was also involved, when I was off-site, in several conference calls (through Skype) with participants from the sites and spent a large amount of time doing remote support work, writing and reflecting. In addition, I made (HMIS-related) learning trips to other countries such as a 2-week trip to India in August 2009 (to assess their HMIS/mobile projects), as well as numerous HMIS-related conferences, meetings and professional advisory roles. For example, since 2012 I have been involved in two working groups of global experts: the United Nations Foundation's mHealth Alliance (Evidence group on Mobile-supported HMIS) and the World Health Organization's mHealth Evidence advisory group on mobile health information system Implementation for Impact and Scale.

As an interpretive researcher, these experiences and exposures added to my understanding and repertoire of meanings and perceptions of HMIS implementation. Some of these external involvements, apart from helping in disseminating results from my projects, also helped me reflect, especially in comparing my experiences with what was happening elsewhere.

Table 4.3a My involvement and fieldwork in the PRRINN project

No	Place & Time/period	Participants, Informants & People involved	Data gathering	Level of investigation	Action research stage/cycle
1	Kano March 2008	PRRINN team and HMIS officers	Discussions on problems and review of results of baseline evaluation	Project, state	First AR cycle (diagnosis and action planning)
2	Katsina April 7-19, 2008	State HMIS staff, district M&E officers	Participant observation and	State, individual (health worker) level	First AR cycle (action taking)
3	Zamfara April 20- 26, 2008	State HMIS staff, district M&E officers	conversations during planning,	State, individual (health worker) level	First AR cycle (action taking)
4	Yobe April 27 – May 3 2008	State HMIS staff, district M&E officers	customizing and training activities	State, individual (health worker) level	First AR cycle (action taking)
5	Jigawa May 4 – May 13 2008	State HMIS staff, district M&E officers		State, individual (health worker) level	First AR cycle (action taking)
6	Jigawa June 29 – July 1 2008	Staff at Birnin Kudu Hospital, Gwaram Primary Health Center (PHC), Kiyawa PHC, Aujara HC	Participant observation and conversations	State, facility, individual (health worker) levels	Second cycle (Action taking & Evaluation)
7	Yobe July 2-4 2008	Staff at Bunyadi Mother and Child Hospital (MCH), Kukareta PHC, Dapchi MCH	during training and supervisory	State, facility, individual (health worker) levels	Second cycle (Action taking & Evaluation)
8	Katsina July 13-15 2008	Staff at Shinfida PHC, Charanchi Comprehensive Health Center (CHC), Katsina General Hospital (GH)	visits to various health facilities	State, facility, individual (health worker) levels	Second cycle (Action taking & Evaluation)
9	Zamfara July 16-18	Staff at Tudun Wada PHC Kuturu Basic Health Center (BHC) Bungudu PHC		State, facility, individual (health worker) levels	Second cycle (Action taking & Evaluation)
10	Yobe Dec1-13	MOH, LGA M& E officers	Participant observation and	State and district level	Second cycle (Action taking & Evaluation)
11	Zamfara Dec 14 – 22	MOH, LGA M& E officers	conversations during training and planning sessions	State and district level	Second cycle (Action taking & Evaluation)
12	Kano Dec 23-24	PRRINN staff	Discussions around evaluation	Project level	Evaluation and reflection
2009					
13	Jigawa	Meeting with State Ministry		State level	

	Jan 18 – 27, 2009	of Health (SMOH) and Health Data Consultative Committee (HDCC)				
14	Katsina Jan 28 – Feb7	Visits to HMIS stakeholders in the state	Conversations and participant observation	State level	Second cycle (Action taking & Eval & reflection)	
15	Kano Feb 15 - 18	State and district HMIS officers	Conversations and participant observation	State, District	Second cycle (diagnosis and action planning)	
16	Katsina Feb 19 - 27	Director of Planning Research and Statistics (DPRS), State Primary Healthcare Agency (SPHCDA), HMIS assistants	Conversations , interviews, and participant observation	State, District	Second cycle (diagnosis and action planning)	
17	Zamfara March 1 - 6	DPRS, State and district HMIS officers	Conversations and participant observation	State, District	Second cycle (diagnosis and action planning)	
18	Yobe March 8 - 13	HMIS officers for Gulani & Potiskum local government areas (LGAs)	Interviews and observation	State, District	Second cycle (diagnosis and action planning)	
19	Kano March 14 - 25	PRRINN HMIS team	Conversations	Project and State	Second cycle (diagnosis and action planning)	
20	Katsina June 8-13	Meeting with HMIS responsible persons at SPHCDA, HMIS, School of Health Technology (HMIS trainers), Disease surveillance officers, Local engagement officers	Focus group discussion, conversations, participant observation During installations and training	Project, state, district	Second cycle (Action taking)	
21	Yobe June 14-19	DPRS, Hospital Management Board (HMB) members, PHC Director, HDCC, HMIS	Focus group discussion, conversations, participant observation During installations and training	Project and state	Second cycle (Action taking)	
22	Katsina July 16-23	Faculty at School of Health Management & Technology (SHMT), SPHCDA data staff, DPRS, HMB, Health Systems Development Project (HSDP) staff	Focus group discussion, conversations, participant observation	Project and state	Second cycle (Action taking and evaluation)	
23	Kano & cyberconfe	PRRINN staff & local consultants	Planning discussions on	Project	Third cycle (diagnosis, action	

	rence and calls from Oslo Sept 22 – oct9		mobile project			planning)
24	Katsina Oct 11 - 16	All HMIS officers in the state, officers in charge of 13 health facilities	Mobile, phone installation, training, focus group discussion	Project, district	state,	Third cycle (action planning and action taking)
25	Yobe Oct 18 - 22	3 HMIS officers in the state, officers in charge of 13 health facilities	Mobile, phone installation, training, focus group discussion	Project, district	state,	Third cycle (action planning and action taking)
2010						
26	Yobe Jan 16 - 23	3 HMIS officers in the state, officers in charge of 13 health facilities	Participant observation and discussions.	State, facilities	districts,	Third cycle (action taking and evaluation)
27	Katsina January 24 - 17	All HMIS officers in the state, officers in charge of 13 health facilities	Mobile, phone installation, training, focus group	State, facilities	districts,	Third cycle (action taking and evaluation)
28	Yobe April 18 – 22	3 HMIS officers in the state, officers in charge of 13 health facilities		State, facilities	districts,	Third cycle (action taking and evaluation)
29	Katsina Oct 25 – Nov 2	All HMIS officers in the state, officers in charge of 13 health facilities, Local engagement officers (LEOs)		HISP, project level		Third cycle (action taking and evaluation)
2011						
30	Kano/Oslo Sept-Nov 2011	PRRINN staff, HISP Nigeria consultants, local HISP consultants (implementers)				Fourth cycle (diagnosis, action planning)
2012						
31	Abuja March 18 - 2012	National HMIS Office, Abuja, Partnership for Transforming Health Systems (PATHS2) HMIS officers	Discussions around web-based DHIS2, and lessons from PRRINN	National, project		Fourth cycle (action planning and taking)
32	Katsina & Oslo August 8-9, 2012	Katsina HMIS officers, HISP consultants	Discussions and helping with DHIS2	Project, State		Fourth cycle (action planning and taking, reflection)
In the first year, I lived mostly in Kano, Northern Nigeria, which was where I had worked for the preceding 2 years. It offered me proximity to the states.						

Table 4.3b My involvement and fieldwork in the NEHSI project

No	Place & Time/period	Participants, Informants & People involved	Data gathering	Level of investigation	Action research stage/cycle
1	Abuja Oct 9-12, 2010	National HMIS officers, National DPRS	Discussions around community HMIS	National, project	First cycle

2	Cross River Oct 20, 2010	CRHDSS data manager and clerks		Project, state, district	First cycle
3	Cross River Dec 15-17, 2010	State HMIS officer, District HMIS officer, CRHDSS team	Planning, installation, Training	Project, state	First cycle
4	Cross River June 1-8, 2011	Commissioner of Health, State HMIS officer, CRHDSS team	Planning, installation, Training	Project, state	First cycle
5	Cross River August 22-29, 2011	Community field workers, data manager and HMIS officer	Discussions, installation, training,	Project, state	Second cycle
6	Cross River Sept 11-17, 2011	HMIS officer and NEHSI staff	Trainings, and evaluation of work done so far	Project, state	Second cycle
7	Cross River Nov 20-27	HMIS officer, NEHSI team	Review of mobile implementation	Project, state	Second cycle
8	Cross River & Oslo Feb 2012	NEHSI team, community field workers	DHIS training further customization, report tables	Project, state, district	Third cycle
9	Cross River May 1-7, 2012	Hon Commissioner of Health, state and district HMIS officers, state Nursing officers, state hospital board data staff, pharmaceutical staff	Discussion with Cross River Team Training and Discussion with participants.	State, district	Third cycle
10	Abuja Feb 18-19, 2013	National HMIS officer, National DPRS		National, project	Third cycle
Data collection was also done through monthly Skype meetings (cyber conferences) with the NEHSI team for most of the project.					
Important acronyms/abbreviations: Primary Health Center (PHC), Mother and Child Hospital (MCH), Comprehensive Health Center (CHC), General Hospital (GH), Basic Health Center (BHC), State Ministry of Health (SMOH), Health Data Consultative Committee (HDCC), Director of Planning Research and Statistics (DPRS), State Primary Healthcare Development Agency (SPHCDA), local government areas (LGAs), Hospital Management Board (HMB), Faculty at School of Health Management & Technology (SHMT), Health Systems Development Project (HSDP); Local engagement officers (LEOs); Partnership for Transforming Health Systems (PATHS2); Partnership for Reviving Routine Immunization in Northern Nigeria (PRRINN), Cross River Health and Demographic Surveillance System (CRHDSS), National Evidence-based Health Systems Initiative (NEHSI)					

4.5 Activities – Implementing HMIS in the field

In both (NEHSI and PRRINN) projects, I was involved in the design, development (customization) and implementation of the DHIS software (the Nigerian government adopted software for managing the HMIS, designed by HISP) as well as integrating mobile data collection for the HMIS. I interacted with managers at local, state and national levels to understand requirements and the workflows of various programs, and incorporated them into the implementation. I participated in and led sessions of software testing, training, documentation, and the analysis of collected data. I also facilitated meetings around the use of the data for decision-making. I engaged with the national HMIS management and partook in national conferences and meetings on the HMIS. Before this study, I also had experience in

implementing the DHIS in other states for a year, and so I had understood the terrain and potential stakeholders at a comfortable level beforehand (in preparation for the research). The timeline of my involvement between 2008 and 2012 is illustrated in table 4.3 (a and b).

I have also been involved in the assessment, design and implementation of emerging HMIS mobile data collection software/components in both projects ranging from mobile facility reporting in PRRINN to mobile community health data in NEHSI. By virtue of involvement in the complexity of making these systems work, I was fortunate to be able to achieve some experience in terms of harmonizing and synthesizing the multiple perspectives, logics and requirements from different organizations and institutions. I also partook in the evaluation of the HMIS; producing both formal project reports and informal low-level field notes.

Much of my fieldwork was within PRRINN, and was focused on Katsina state in particular though I was actively involved in Yobe, Zamfara, Jigawa states, as well as Cross River state (in the NEHSI project). This was because I spent more time in Katsina for most of my period with the PRRINN project and in Northern Nigeria, as this location offered more safety and security. Thus, Katsina is the primary focus here and sometimes assumed as representative especially as Northern Nigeria is largely a homogenous area. Nevertheless, the data collected cover the higher national level (through interactions with the national HMIS office in Abuja), as well as lower levels, the districts and health facilities, as table 4.3a and b show.

4.6 Levels of investigation – Unit of analysis and objects of study

To meet the research goal of achieving a holistic understanding and informed interpretation, a multilevel design was considered appropriate. This informed multilevel data collection and analysis; and aligned with advice that institutional analysis should consider not only the local organizational, but also the broader national context (macro), as well as micro individual levels (Avgerou, 2001). Thus, the fieldwork involved engaging actors within the different levels of the HMIS, including but not limited to; national, state and district health managers; HMIS staff at national, state, district and community levels and other partnering or allied actors at these different levels.

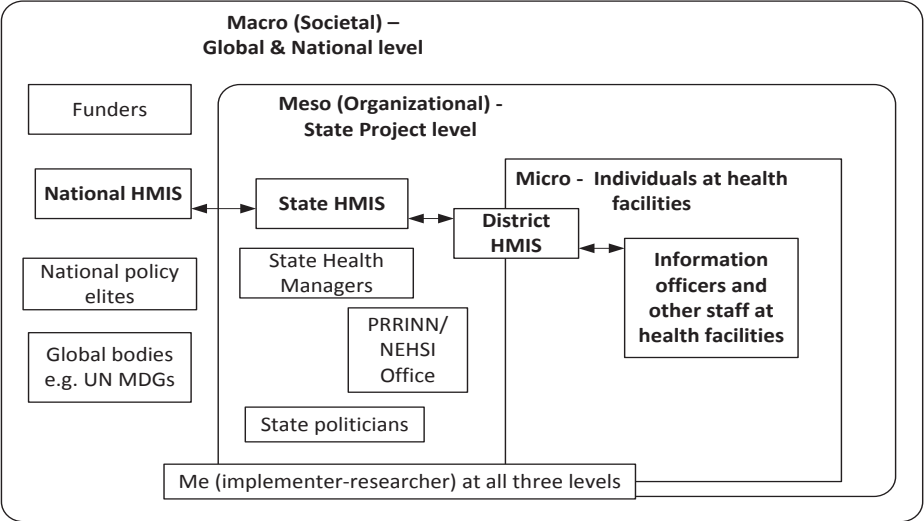


Figure 4.2. Levels of investigation. The arrows show the data flow in the HMIS

Using the model above, inspired by (Gilson, 2012), the units and levels of analysis include; the national level (macro), the project organization, state and district (meso); and the level of community and individuals such as health workers (micro). However, as expected in organizational studies of IS, greater focus was given to the meso level (project organization, state and district) while paying attention to the agency of individual actors and the macro effects of national policy, trends and society level logics.

However, across all levels, my focal objects of study and analysis in this research, in line with institutional logics literature (Thornton et al., 2012) was on organizational practices and symbols, which I explain in more detail in the following subsection.

4.7 Institutional Logics & Data Collection/Analysis Strategy - Looking Out For Symbols And Practices

As explained in chapter 3, the conceptual framework chapter, this investigation will utilize the inter-institutional system as well as the institutional complexity framework inspired by the institutional logics lens. However, exploring institutional logics means exploring the symbolic and the material (practices). This is because institutional logics in society have both material and symbolic aspects (Thornton et al., 2012). The material aspects are the core organizational practices, while the symbolic aspects refer to the meaning (Thornton et al., 2012).

“Practice refers to forms or constellations of socially meaningful activity that are relatively coherent and established.” (Thornton et al., 2012, p. 128). Practice is the whole set of activities that are related or linked, but activities are simply those tasks in everyday work. Lounsbury and Crumley (2007) put it nicely too: activities are simply actions carried out, which are essentially lacking in deeper social meaning or reflection such as carrying a form or “pounding a nail, while practice, such as professional carpentry, provides social order and deeper meaning to a set of otherwise ordinary activities”. There is a link between logics and practice in that practice occurs based on some underlying logic, which they reflect.

On the other hand, symbols represent the cognitive aspects - ways of ordering reality. Essentially, a symbol is a powerful tangible indicator of organizational life (Rafaeli and Worline, 2000). We know that a place is different from another by the things we find present or absent. As Rafaeli and Worline (2000, p. 2) explain, “we know a lot about each place through our associations and inferences from objects - such as switchboards, elevators, conference tables, cash registers, linoleum floors, and plastic trays.” Symbols refer to things that stand for the ideas and concepts that constitute the organization. That is, they are visible and audible physical manifestations of organizations, serving as clues and pointers to organizational life. As such, symbols expose important meanings in organizations; meanings that are defined by social interactions and conventions. Things such as organizational landscape, organizational layout, and organizational dress are examples. In the HMIS, I observed for these in the different organizational arenas that HMIS activities (and practices) take place. The practices and symbols were entangled and involved each other: symbols were embedded in the HMIS structures and practices, and the practices propagated and used symbols as (Rafaeli and Worline, 2000; Zilber, 2008) also describe. Thus, there was no apparent value to necessarily differentiate or go to lengths to distinguish them. For example, at the sight of a book containing data in ANC visits (e.g. an ANC register), we associate the setting as symbolic of an ANC clinic with some or all its practices (and organizational members).

This general focus on symbols and practices has informed my approach. In general, my data production strategy was based on gathering data from the activities I listed in section 4.4, through immersion in the institutional context and participation within project activities. As I discussed earlier I partook (not just observed but also was actively involved) in activities around the different aspects of HMIS implementation including design, customization, testing, training, planning, etc. Through immersion in these activities, I explored HMIS symbols and practices.

In sum, to capture the institutional logics, I observed and collected data on organizational practices and symbols, mainly through exploring the perceptions, perspectives, routines, messages and activities including patterns and changes over time within the implementation project. This resulted in my understanding and interpretations.

4.8 Data collection

4.8.1 Ethnographically informed strategy

In alignment with my interpretive approach and the design for immersion in the context, I adopted a data gathering process based on an ethnographic approach to information systems research (as discussed by numerous researchers e.g. (Benson, 1983; Beynon-Davies, 1997; Harvey and Myers, 1995; Myers, 1999). My objective was to observe, gather perceptions and perspectives, and in doing so paying attention to practices and symbols, combining conceptions and constructing an understanding (interpretation) of the context, in relation to the research question. My data collection was thus qualitative and geared towards understanding the problems and actions based on constructing a complex holistic picture, fashioned with captured words and carried out in a natural setting (Creswell, 2007).

This study followed the principles of action-oriented participative longitudinal research (Pettigrew, 1990; Walsham, 2006): It was time-aware, engaging with the research site at several times during the study, and collecting data reflecting patterns and changes over time. It involved participant observation designed to understand the actors' language and problem solving, and making sense of different everyday situations in the usage of the HMIS in the organizations. The study was analytically informed; based on both an analytical lens (though one that evolved into institutional logics) as well as a multi-level investigation.

This ethnographic approach helped me in achieving immersion and depth as other authors such as (Beynon-Davies, 1997; Myers, 1999) have described. I was able to be in the field for long periods and see firsthand what people were doing, how they were doing it (and saying it), and what they felt. There are criticisms (Beynon-Davies, 1997) that such an approach takes time and effort, and risks generating an overwhelming avalanche of data but I found that it provides a rich way of studying HMIS institutional contexts with all the sociocultural, political and technical complexities intact.

4.8.2 Data collection methods

Primary data for this study have mostly come from field notes taken during participant observation as well as a combination of document collection, conversations and informal interviews, and group discussions. The combination of these methods was useful in identifying and capturing the thoughts

and shared knowledge from participants. Personally, I really enjoyed the field visits and the direct observation in situ the most, as they were very stimulating and helped me immensely in learning the context and in testing and constructing interpretations.

Participant observation

Participant observation (Jorgensen, 1989; Spradley, 1980) as a method involves studying social settings through participation in the context by the researcher. People being observed are expected to act more openly when researchers participate in the social setting.

I found this method to be a 'natural' method (not obviously intrusive) to study the HMIS social setting and its symbols and practices with less interference from me as the researcher. People being 'informally' observed acted much more naturally, even as I, the researcher, participated in and studied the social setting. It also resolved the discrepancies between what people said in formal 'questioning' sessions with the reality of their daily experience. Combined with informal interviews, I found such immersion a good way of providing a more complex picture of the social processes in the context (Forsythe, 1999). My observations took place in HMIS organizational arenas such training sessions, seminars, discussions, meetings and at the project sites such as health facilities, district offices and state HMIS offices. The observations involved the wide range of social and natural environments of health workers, district officers, HMIS officers, state health managers, officers from the NGOs and funders, and their interactions with the HMIS.

These environments were a rich source of symbols and practices of the HMIS organizational life. In fact, just visiting an HMIS office and observing the organizational layout, which is a powerful organizational symbol of authority in itself (Rafaeli and Worline, 2000) was helpful. For example, a large office with two to three tables and air conditioner and a computer symbolizes a position higher in the hierarchy compared with a an office with many data entry, full with stacks of paper, and no air conditioning.

Participating and observing for all these occurred in all phases of the action research cycles. I observed how routines and organizational messages were sent and followed, and how the different processes occurred. Photographs were also taken during observations.



Figure 4.3 A Primary Healthcare (PHC) Facility in Fika LGA, Northern Nigeria

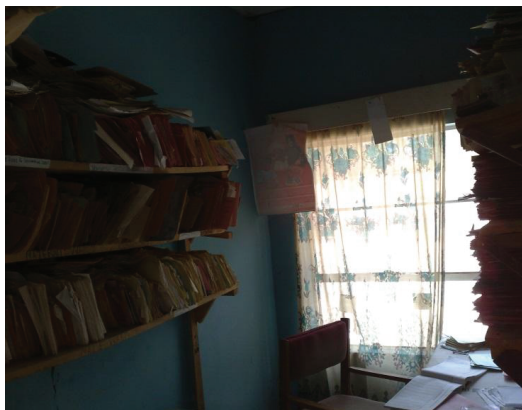


Figure 4.4 Health Records in a health facility in Fika LGA, Northern Nigeria



Figure 4.5. State HMIS and M&E officers interviewing PHC coordinator

The photographs helped capture the context, norms and practices, and were useful in reminding me (especially during the analysis) of the symbols and practices in the setting I had worked in. For example, the decrepit nature of a rural community health worker's post (Figure 4.3) signifies, in the Nigerian context, a low position in authority and hierarchy, whereas an office with a little more care (with a proper window) and functioning stationery and files, basically connotes a higher position in the organizational hierarchy and the data collection chain. I found that even before interacting with people, I could glean a lot by observing and listening for such organizational symbols in the context.

What was also interesting was that some of the pictures I had taken assumed more meaning later, during the writing and reflection process, as I formed interpretations of observations, in similarity to descriptions by (Banks, 2008, p. 757; Denzin and Lincoln, 2005) on visual data aspects of qualitative research. Participant observation also helped guide my choice of who to discuss in more detail with. As part of my observation, I noticed that higher level meetings generally tended more to be policy oriented as well as overly optimistic (with plenty of back patting), whereas lower level meetings were more problem focused and pragmatic. Therefore, I tried to achieve a balance between these levels and focused discussions with the more involved participants.

Informal group discussions

I conducted few (about 8) focus group discussions (each lasting between 30 and 90 minutes) with district M&E officers, health facility workers and community health workers. Focus group discussions were useful when I needed to reveal ideas, feelings, opinions or motivation from a group of HMIS participants about certain issues, especially when trying to get a sense of the norms and shared beliefs (institutional logics) among them. Here the interaction among the group members helped construct group meanings and norms, which could be hardly achieved by individual or formal group interviews (Purwandari et al., 2010). Web conferencing was also leveraged in the conduct of some of these discussions, which held using web conferencing software, Skype, especially in the later years of my study when internet access and usage considerably improved in the states.



Figure 4.6. A group discussion during an HMIS implementation evaluation field trip

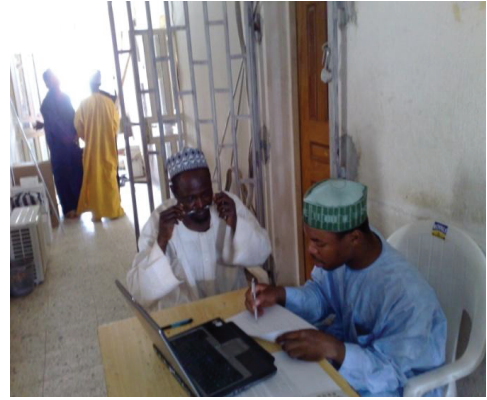


Figure 4.7. The researcher (seated right) working with a state HMIS officer (seated left)



Figure 4.8. The researcher with participants, during a training session



Figure 4.9. Looking out for what kind of phones people use, in trying to understand the context of mobile use by HMIS workers.

Conversations and Informal interviews with individuals

“A careful cultural researcher can uncover meaning through exploring the uses of symbols in everyday conversation. As a frame for organizational experiences, symbol provides a currency for discussion of otherwise abstract or ambiguous notions that are critical to the organization. Understanding an organizational culture can be facilitated by listening carefully to conversations about symbol” (Rafaeli and Worline, 2000, p. 3)

This applies also to studying organizational practices. I learnt much from the conversations and informal interviews I conducted at all levels. The key informants ranged from health workers at the healthcare facility level, health managers at the district, regional/zonal and national levels, and project managers mainly at the district and state levels. In most cases, it was with single individuals, but occasionally with two to ten people, and occurred in a wide range of settings from the official working areas to corridors to even a lunch under the tree.

The conversations (informal interviews) were mostly unstructured and open-ended. However, the focus became narrower as conversations proceeded. During the earlier stages, conversations were focused on understanding the organizational context and the daily work practices. During these initial discussions, I applied the snowball technique where as I discussed further I was introduced to more

knowledgeable people in the organization. As time progressed, I found out and discussed with many knowledgeable people in the HMIS and its enveloping ministry of health. I also noticed that some of the district level people had the best and most comprehensive knowledge of both state and district level information.

Document study

To supplement the field notes and interviews, a range of documents, as secondary sources, was also gathered for documental analysis. I tried to collect as many sources as available, including meeting agendas, strategic reports, policy documents, memos, and bulletins. In addition, I collected and reviewed HMIS paper-based forms, numerous reports on evaluation and statistical data reports, and others (please see the table below). Much of the document review was conducted in the early stages, and helped in guiding the research, and sometimes acting as references for information e.g. on lists of organizations and hierarchical units in the ministry for customization within the DHIS, NGO and funder’s mission and plan documents.

In viewing these documents, I tried to review them to identify statements and views on or related to the HMIS and its underlying institutions, as well as opinions and visions expressed by the HMIS stakeholders.

Table 4.4. A few documents collected and used.

Documents collected
HMIS Paper forms and registers
Print out of reports
Internal circulars and memos, information booklets
Screenshots from computers
HMIS export files
HMIS organizational chart
Meeting agendas and minutes
State-level reports and plans like the State Economic Empowerment for Development (SEEDS) documents
National HMIS Policy documents
National Development Policy documents
Documents from PRRINN and DFID



Figure 4.10 Filing of HMIS records in a Health Facility

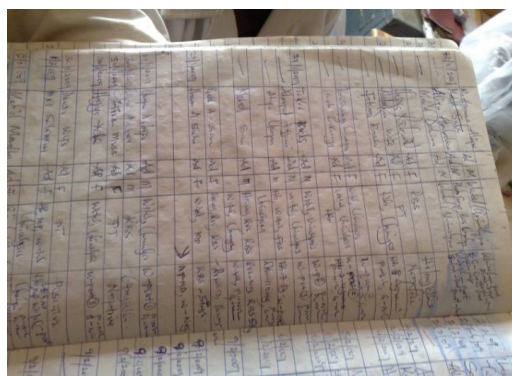


Figure 4.11 Patient health data filled in a notebook due to lack of HMIS register

Table 4.5. Summary of data collection for this study.

Data gathering	Result
Participant observation	Field notes
Conversation and informal group discussions	Discussion notes and summaries
Informal interviews	Notes, and some recordings
Documents	Reports, policy, strategy documents

4.9 Data analysis

In this thesis, while I discuss the data analysis and data collection separately as if they were individual phases with a stepwise process leading from data collection to analysis, it is important to note that this separation is for discussion purposes mainly. Both processes were concurrent and overlapping. Essentially, the analytic process for this thesis started right from the interpretive process in the fieldwork. As I observed and discussed in the field, I was constantly processing information and constructing meanings. As I explained in the section on action research, the initial sense-making phase was not guided by institutional logics. Essentially, as the study progressed and as I looked through the initial data, I moved from a vague interest in analyzing complexity and settled finally on the institutional perspective, as I felt it was an appropriate theoretical lens for exploring the socio-organizational phenomena of interest, and it had a good fit with my data. Hence, the focus of analysis narrowed on the implementation project, taking it as an inter-organizational space where the actors and their institutional logics and rationalities play.

My attention became focused on capturing the logics through understanding organizational practices and symbols, which I mainly did as I interpreted and sought interpretations for views, perceptions, decisions and actions carried out and expressed by various participants at different levels of the HMIS implementation. For example, I closely followed the logic and rationalities of how the NGO and the government made their decisions, relating it to my previous conceptions, my informants' perceptions and clarifications, and then drawing conclusions on institutional context and logics. Indeed, it was such a qualitative process involving analytically combining ideas and letting the phenomena emerge (Silverman, 2005).

However, more of the analysis took place as I began to write papers and read/discuss about concepts and theories, and especially as I began to think of this final thesis summary. It was not a straightforward and linear process but a long and difficult process, though exciting nonetheless.

Thus, in writing this paper-based thesis, I am aware that my research has included two levels of analysis. The first level began during my initial period of writing the papers, and the second took place when I synthesized insights from the papers into this coherent whole. Some of my papers in this thesis have been strongly empirical, and some have had to be tuned to the editorial viewpoints of conference and journal calls for submissions.

My analytical process involved reading and rereading my collected data to capture what was 'really happening' in the data using this institutional lens; teasing out the multiple and sometimes conflicting logics of the different institutional actors in the different phases.

Thus, data analysis - moving from raw data to interpretation - was based on an iterative and dialogical process of reviewing collected data and literature, partaking in formal and informal discussions within the research group, writing and getting comments on research papers and identifying/exploring recurring themes from the field data. It was a hermeneutic process of sense making where continued

testing of concepts and alternative explanations led to deeper understanding and growing analytical sophistication.

Though most of it was manual, I have used three software applications to assist in this analytical process; Nvivo, to assist in qualitative analysis program (QSR-International, 2010); Qiqqa (Glassman and Sorensen, 2012), a research management software (mainly for document analysis and managing literature search and analysis); and CmapTools, concept mapping software for concept linking and display process (Cañas et al., 2003).

I spent some of this time doing displays where I mapped concepts with data, sometimes attempting to code the data using thematic categories. For some part of the analysis, I transferred and coded data in the Nvivo software, where case dynamics matrix displays were also generated based on thematic categories from the institutional perspective.

During the coding (both computer-based and manual), I developed a start list of codes, as described by Miles and Huberman (1994) based on theoretical and method-based categories (Bogdan and Biklen, 1998) especially codes on different aspects that I wanted to explore in the data (Bradley et al., 2007). Particularly, these codes were drawn from theory and included logics from the inter-institutional system (capitalism, bureaucracy, etc.).

In addition, they included codes on the HMIS hierarchy where the data came from and the people there e.g. community, facility, district, state, national levels. I also included codes from participant roles - governmental, funder, etc., and other codes, some of which are summarized in table 4.6 below.

Table 4.6 Some of the codes used during analysis. (Some were within Nvivo, but most were manually searched for in my data using the traditional method of reading and rereading). Some of these codes were dropped (for example, the mimetic, coercive and normative codes), others were changed, and others were utilized as-is for the analysis and interpretation.

Action research cycles	Action research phases and participant	Some institutional analysis related codes	Other logics related ones
Phases 1 – 4 for PRRINN project	Diagnosis, plan, action,	Bureaucracy, coercive, mimetic, normative, organizational routine, institutional conflicts (for conflicting logics)	Decentralization, development, democracy, funders, funding, project centric, national-political, state, price/cost, sustainability and ownership, universal coverage, resolution of conflict, economic logic,
Phases 1 – 3 for the NEHSI project	evaluation, reflection		
Tasks, level and practices	Technology	Institutional complexity related	Some codes from theory for which I found no data for
Data collection task, data flow, hierarchical, network, data quality, district, community, state, facility	Desktop computer, mobile, server issues, professional’s view	Multiplicity and heterogeneity, historicity, power issue (linked to hierarchical), institutional conflicts, identity issue	Family logic, religion logic (from the interinstitutional system)

Figure 4.12 below is a screenshot from Nvivo when I was writing one of the papers in this thesis. The code categories (or nodes, in Nvivo parlance) are on the left pane and include codes on the action

research phases (diagnosis, action taking, action planning, etc.), the action research cycles (1 – 4), some codes related to institutional theory, codes on the organizational (hierarchy) levels and the environment, and in addition some codes I added in the analytical process. (The right pane shows those codes I added in the coding process, with the number of occurrences at that stage.) Some of these codes had changed from earlier codes and some (for example, ‘work culture’) were not pursued further in this research because I found less relationships than other codes, as I also wanted to narrow in on the codes with more dominant findings such as those related to logics and tasks and practices.

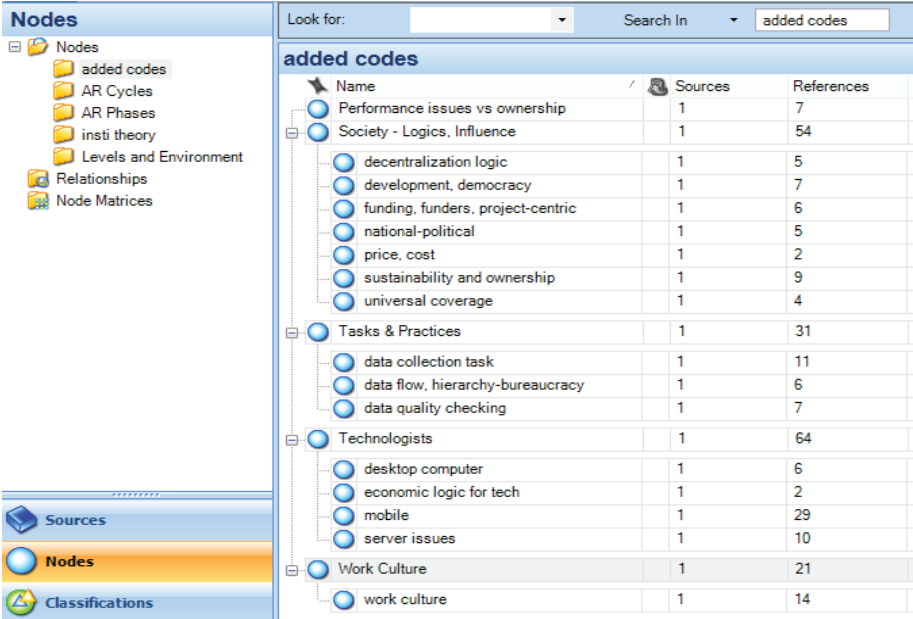


Figure 4.12 A screenshot during my work on the analysis.

The coding process (both using Nvivo and done manually) involved linking chunks of data (text representation of the same phenomena together, towards constructing a deeper understanding of my questions and context.

For example, I frequently checked to see if the same text had been coded for different concepts, and if there was any potential relationship that may exist between matching codes. In Figure 4.5 below, I have made a screenshot of a coded portion of my data. The screenshot shows on the left, the text I had coded with the concept ‘server issues’, while on the right, it shows other concepts I had coded to the same text e.g. ‘context’, ‘sustainability and ownership’ (coming from the data), ‘Society – Logics, influence’, ‘Decentralization logic’ (coming from theory). In addition, the action research phases where the server issues occurred - ‘diagnosis’, ‘plan’ and ‘action’ phases - can also be seen (to have been coded) on the right pane, such that I was able to link concepts to the they were occurring in, as well as to other concepts occurring in same phase (all these motivated by the search for qualitative relationships).

In general, with such matching and search for relationships, I could then explore explanations, for example I could interpret that the server issues (moving the server to the state HMIS office, in this case, as you may see in the figure) during that particular action research phase (action phase, in this case) was linked to trying to achieve sustainability and ownership (the sub-logic that was coded in this

example). Thus, the low-level textual coding enabled a higher-level understanding (through these linkages achieved by code matching), which I then projected into an integrated interpretation and wrote up - for example, this was written up in paper 1 (see more in findings chapter).

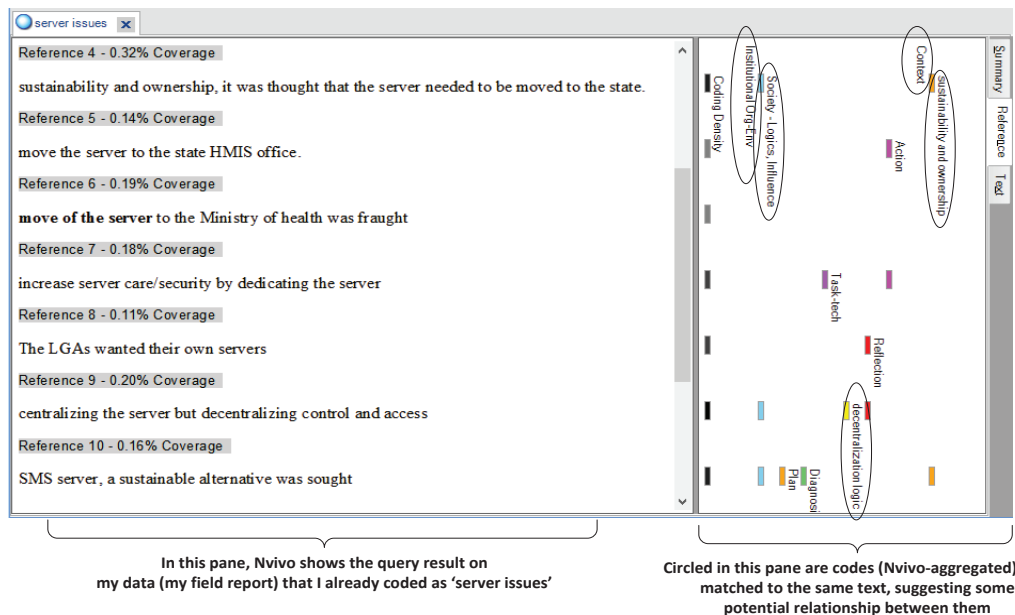


Figure 4.13 A screenshot from my coding process. This example shows the text (left pane) and other codes (right pane) related to the code 'server issues'.

Thus, as I progressed from writing papers to writing this thesis, the analysis became more about linking up papers and the concepts. Most of it became more manual because I was getting used to the technique of matching text with concepts and then concepts to each other, and also because I could not cope with coding the very large amount of material in Nvivo. It is important to note that I used coding mainly in the main paper of this thesis (paper 1 in the section on findings, which I discuss later), but the lessons learned were used in subsequent papers.

In addition, being aware of the risk of confirmation bias with my interpretations, I did share my interpretations and research paper drafts with participants in the organizations I worked in – and they agreed with most of my interpretations but explained where they felt things could be better explained and understood (and thus helped shape my writing as well).

In sum, this process of analysis involved both deductive and inductive elements. The deductive aspects involved drawing inspiration from previous work, discussed in chapter 3, that are based on institutional logics analysis using ideal types e.g. (Blatter, 2003; Freidson, 2001; Goodrick and Reay, 2011, 2011; Nicholls, 2010; Rao et al., 2003; Thornton and Ocasio, 2008, 1999; Thornton et al., 2005, 2005, 2012; Thornton, 2002, 2004, pp. 808–809). From this perspective, the broad coding categories used included the society level logics adapted from literature – mainly Friedland and Alford's (1991) logics in the inter-

institutional system, which the authors listed above also used as an overarching typology of ideal type categories to frame their analysis and ideal type identification from data. This is what I have adopted likewise, for my empirical analysis, which essentially involved assigning and labeling portions of my text into these predefined categories derived from the society level institutional logics.

In the inductive part of the process, on the other hand, the sub logics came from my data in a conjecturing process that involved getting new insights and interpreting my data. In fact, the hermeneutic process I was involved in, of testing different explanations to see which fit best, is essentially an inductive process of interpreting the data, letting the data guide the interpretation and reformulation of concepts.

For example, in the example given previously, the sublogic of sustainability and ownership have come from my data (as I showed in the figure) and I was able to link this to the institution of state (social democracy) in Friedland and Alford's (1991)'s initial conception of society level logics.

In summary, the answer to research question 1 (Contribution 1) can be seen as a culmination of the deductive process of ideal type analysis where the society level logics were used as broader categories, as well as an inductive process where I identified and generated sub logics from the data. For the complexity analysis (research question 2), it was a mix of deduction and induction: I used the broad categories I proposed (conjectured) as a lens to view my view, mainly searching my data and allocating units to the different aspects.

My analysis for research question 3 (understanding resolution strategy) was largely inductive. I largely described the patterns I found in the data, and constructed the labels for the two categories (changeover or transitional resolution and dialectical resolution) that I used. Nevertheless, I also reviewed literature, for example, comparing it to the alternative resolution process of deinstitutionalization, and in addition confirmed that these had not been described before and thus was able to label it a contribution to the body of knowledge).

In summary, I made use of both existing work and data collected to shape my field interpretations and inform the iterative process of data collection and data analysis. In fact, I am aware that "the selection of any given theoretical concepts is both a way of seeing and a way of not-seeing, since the use of a particular theory excludes other ways of viewing the same events" (Walsham, 1993, p. 70). Thus, I do not make the case that this is the only way the data could have been interpreted. However, I continually tried to share my interpretations with colleagues and even informants, and learned from their comments. I also tried to triangulate their different perspectives at multiple levels in order to arrive at the multilayered and nuanced understanding that I present in this thesis on the logics of HMIS implementation in Nigeria.

4.10 Reliability

I have tried to pay serious attention to reliability of the research, which I base on following Klein and Myers (1999) set of principles, which provide criteria for evaluating reliability of interpretive research. They include my decision to follow a hermeneutic process, basing interpretation on the context (social and historical background), the principle of reflexive interaction between me and the participants, applying theoretical concepts, ensuring that the interpretation truly matches the data, always considering multiple interpretations (understanding that the same story can have different narrations

because of different logics), and lastly a sensitivity to systematic distortion of participants' narrations. So, I double-checked and followed up on the validity of the emergent results by also sending my reports/notes and initial drafts of my papers to participants from the project, and I received comments that made me add or subtract as was deemed appropriate. (I am indebted to them for helping me in the analysis, as they helped validate my interpretations).

4.11 Reflections on the process and the challenges

I am of the opinion that as researchers, we hardly approach our research 'tabula rasa' without any preconceptions and basic assumptions regarding the phenomena of interest. Our training, conceptions, personal values and interests and beliefs all feed into the complex milieu of the research environment and its products. While in positivist research, this is considered as a bias and a disadvantage, this is instead an advantage in interpretive research. Being able to accept that this research is an interpretation of the interactions and experiences emanating from the fieldwork, which itself was participatory and inclusive, gives one a sense of reflexivity and quality to the work.

However, what I considered a challenge to this approach is how to achieve still some analytical distance to the context. Often, being immersed in the practical details of empirical work creates a situation where it may be challenging to see the big picture or see what is surprising in the context. In my case, I have lived in Nigeria all my life (except for part of this PhD), and my research sites were very much familiar and usual to me. For example, the Akpabuyo site in the NEHSI project is only 20 km from my hometown and place of birth, and I had worked as a physician in the area of the PRRINN project for over two years before my research. Therefore, it was often interesting when I interacted with visitors to the field site as well as researchers from HISP, as they would express their surprise at a couple of things I found usual in the context, eventually pointing out to me phenomena that I investigated further. Making explicit notes and recordings of phenomena and revisiting my data when I was far away and physically removed in Oslo allowed me sufficient distance to reflect on what was happening in the data and in the field. In this respect, I agree with Klein and Myers (1999) who highlight the importance for researchers to be explicit about their own background and intellectual basis, and to insert a caveat that their result is their own interpretation, influence by their locale and history.

In addition, because of the deep involvement, I grew familiar and close to the participants, many of whom I saw or met over the course of years of fieldwork. However, within my first year, I found that formal interviews became difficult and created a contrived and unnatural situation, where it appeared as if the interview was 'time to speak in official tones'. This is especially so in Nigeria, where after three decades of military rule, there is yet to be a truly free atmosphere to talk within office settings, especially more so when I had a sheet of paper 'ready to scribble' or immediately I took permission to record the discussion. I often resorted to taking notes at the end of the day after such discussions. However, in a few occasions, I was put into a quandary where I was provided with important details yet warned that this should never be published or documented. In fact, out of concern for not portraying some people 'in good light' (as they would want to), I published about them anonymously (without mentioning them explicitly as one can observe in the main paper of this thesis). These are aspects that I hope to continue to improve on, learning how to handle better such situations and how to balance such diverse but combined roles as being change agent, critical friend, collaborator/moderator, and researcher. Overall, I continue to treasure the open doors and access I had to the HMIS units and collaborators through the two projects I worked on. The only time I had reduced access was when PRRINN largely relocated their staff from some of the largely unsafe areas of Northern Nigeria.

4.12 Summary

In summary, this chapter discussed the motivation for the research approach, including the ontological and epistemological assumptions (interpretivism) and the real-world concerns for problem solving and impact that led to the appropriate choice of a participatory action research design. It also discussed how the data generation and analysis were influenced by the interpretive and action-oriented nature of the research. It outlined the fieldwork in detail and reflected on the research approach, the challenges faced and how they were handled.

Table 4.7 Overview of research methodology.

Setting	Research Approach	Research technique	Analysis
The Nigerian HMIS	Action Research Interpretive research	Participant Observation with document collection and informal interviews	Document analysis, Coding, Interpretation through a hermeneutic cycle, Informed by theoretical concepts

I have also reflected on how my mix of intermittent but extensive field trips and periods of reflection away from the action permitted an iterative hermeneutic approach to the fieldwork.

I also discussed how I used CAR, considering it as an ideal model but adapting it to my situation as necessary. That is, my use of canonical action research was not as a purist idealistic approach but one modified to the messy reality of a complex inter-organizational client structure and constraints peculiar to a low resource context.

CHAPTER 5: FINDINGS & RESEARCH PAPERS

This chapter presents the findings in this study. It draws upon five papers by the author published in peer-reviewed journals and one conference proceeding. The chapter is structured in two parts. In the first part, a table of the constituent research papers (see Table 5.1) is presented, as well as a discussion of each paper, highlighting the respective problems, research aims/questions, the conceptual approaches and the empirical setting and findings. The second part presents a summary of the preceding discussion, but highlighting how the papers have contributed to the thesis goals.

5.1 The Papers

Table 5.1. List of papers.

Paper	Author(s), date, title, publication
1	Asangansi, I. (2012). Understanding HMIS Implementation in a Developing Country Ministry of Health Context - an Institutional Logics Perspective. <i>Online Journal of Public Health Informatics</i> , 4(3).
2	Asangansi I (forthcoming). Is mHealth Disrupting the Status Quo? Evidence from Implementations Highlighting Network vs. Hierarchical Institutional Logics. Submitted December 2013 to <i>Electronic Journal of Information Systems in Developing Countries (EJISDC)</i>
3	Asangansi, I. & Braa, K. (2010). The emergence of mobile-supported national health information systems in developing countries. <i>Studies in Health Technology and Informatics Journal</i> , 160(1), 540. (Initially presented at MEDINFO 2010 Conference, South Africa)
4	Asangansi I, MacLeod B, Meremikwu M, Iwara A, Roberge D, Hartsock B, Mbotto I (2013) Improving The Routine HMIS In Nigeria Through Mobile Technology For Community Data Collection. <i>Journal of Health Informatics in Developing Countries</i> vol 7 issue 1 p76-87
5	Asangansi, I. & Shaguy, J. (2009). Complex dynamics in the socio-technical infrastructure: The case of the Nigerian health management information system. <i>Proceedings of the IFIP9.4 10th International Conference on Social Implications of Computers in Developing Countries, Dubai</i> .

Paper 1 - Asangansi I. (2012) Understanding HMIS Implementation in a Developing Country Ministry of Health Context - an Institutional Logics Perspective. Online Journal of Public Health Informatics 2012; 4(3) (Full paper is in thesis appendix)

Problem

Health management information systems (HMIS) have been hailed as important tools for health reform. However, their implementation has become a major challenge for researchers and practitioners because of the significant proportion of failure of implementation efforts. Researchers have attributed this significant failure of HMIS implementation, in part, to the complexity of meeting with and satisfying multiple (poorly understood) logics in the implementation process.

The aim of this research was to improve our understanding of HMIS implementation (involving paper-based, computer- and mobile aspects) through identifying and exploring the multiple institutional logics (and conflicts) that influence and shape the implementation trajectory. It also aimed to explore how conflict in logics may be resolved.

The central concept is that of institutional logics. The setting is the PRRINN project in Katsina state, Northern Nigeria. The research approach is action research (four cycles), employing mostly the ethnography-inspired technique of participant observation and informal discussions during the period through my direct involvement in planning and training participants, as well as customizing and deploying the HMIS.

Findings

This paper reports on the institutional complexity within the HMIS implementation in Katsina state that arose due to multiple conflicting logics from the participants. The paper exposes these conflicts in logics as tensions such as the tensions between short-term focus vs. long-term infrastructure building; small-scale pilot approach vs. large-scale (universal) approach; vertical approach vs. horizontal (multi-system) approach; as well as tensions between ownership and performance, decentralization vs. centralization and hierarchical control vs. open network approach. These are well discussed in the paper, as emanating from the dominant logics from the nongovernment organization, the state and district governments and the ‘technical’ implementers – all competing for dominance in the project’s thought process, at different stages.

Contribution to broad thesis aim: It is the most comprehensive paper of the thesis, providing a much broad look (2008 to 2012) of my involvement in the HMIS implementation project in Northern Nigeria and discusses how the project evolved through decisions made based on different institutional logics. It highlights the organizational context and conceptualizes the tensions (conflicts) between a number of identified institutional logics as well as the mechanisms through which the conflicts are resolved.

Figure 2 below summarizes case dynamics through the action research phases, illustrating the logics and conflicts encountered.

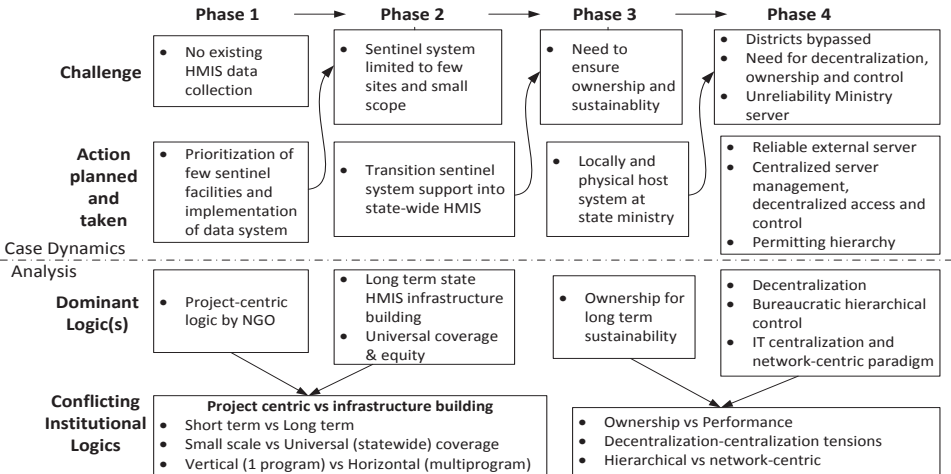


Figure 5.1. Case dynamics matrix showing the dynamics of the case, and the logics.

Using the findings, I argue for an expanded understanding of HMIS implementation that recognizes various institutional logics that participants bring to the implementation process, and how these are inscribed in the decision making process in ways that may be conflicting, and increasing the risk of failure. I also propose that the resolution of conflicting logics can be conceptualized as involving deinstitutionalization, changeover resolution or dialectical resolution mechanisms. I conclude by suggesting that HMIS implementation can be improved by implementation strategies that are made based on an understanding of these conflicting logics. In addition, preempting and planning for these logics and tensions may enhance the prospects of HMIS implementation success, especially in developing country MoH contexts.

Paper 2 – Asangansi, Ime (forthcoming). Is mHealth Disrupting the Status Quo? Evidence from Implementations Highlighting Network vs. Hierarchical Institutional Logics. Submitted to *Electronic Journal of Information Systems in Developing Countries (EJISDC)* (Full paper is in appendix)

Problem: This paper explores a challenge that was experienced in attempting to institutionalize mobile data collection within the hierarchical setting of the HMIS.

Essentially, networked technologies such as mobile technologies used in mHealth-based data collection introduce into the organization a network logic that needs to interplay with the traditional hierarchical logic of the HMIS and the Ministries of Health (MoH) in which they are embedded. For example, with the implementation of mobile data collection in the two projects (NEHSI and PRRINN), the statewide network of remote health workers could submit data directly from the lowest levels up into the central state server. In doing this, they bypassed multiple levels of authority (especially the districts), and in effect weakened the hierarchical control and bureaucratic layers that was based on stepwise submission of data from one level to the other. This created a tension between, on one hand, the pre-existing hierarchical institutional logic and those who subscribe to it and, on the other hand, the open network hierarchy-free logic. The latter helped to improve efficiency and speed of data submission but threatened existing institutional arrangements as it rendered some of the mediators (like the district workers) either redundant or less relevant in the information chain.

Contribution to broad thesis aim: The analysis in this paper was based on institutional logics. It uses data from both PRRINN & NEHSI action research projects.

Key findings include the following: Data collection and reporting involves both the technical aspect of filling forms and transferring the data as well as socially symbolic aspects based on the perception and arrangement that ‘juniors report to seniors’. In such an arrangement, implementing more efficient means of meeting the technical need but bypassing some ‘middle personnel’ may disrupt existing the institutional arrangement. In this case, mobile data collection represents a threat to some aspects of the HMIS bureaucracy – as some participants that were rendered redundant through the bypass in the implementation lost their jobs/roles. This links to the previous debates in information systems literature that technology implementation can lead to the disruption of hierarchies and the flattening of organizations.

Thus, this paper finds that the institutional aspect of mobile data collection implementation that is sometimes taken for granted might have serious implications for how mHealth data collection could be successfully implemented. This paper finds that these projects had to address both network and hierarchical logics by embedding some level of hierarchical control in the networked data submission. Those bypassed feel a loss of power and authority, and a loss of inclusion or participation in the implementation process. They need to be involved. The implications for mobile-supported HMIS is that the implementation process needs to be aware of institutional arrangements, dominant logics, power structures and the conflicts that can result from introducing a technology that can disrupt pre-existing hierarchical organizational structures. While this may not be entirely new to the broad IS literature, it is a discussion that has been lacking within the mobile HMIS domain of research, as well as the development literature.

Paper 3 - Asangansi I, Braa K. (2010) The emergence of mobile-supported national health information systems in developing countries. *Studies in Health Technology and Informatics Journal*. 2010; 160(1):540. (Full paper is in thesis appendix)

The problem this paper addresses is the failure of the HMIS to function appropriately at the lower levels of the health system (the districts and health facilities), where infrastructure is poorest. Because of this failure, health managers and decision makers lack information to guide public health reform and planning.

The aim of this research was to explore how mobile technology could help scale the HMIS to the lower levels (the grassroots) of the health system.

The research setting involved Katsina and Yobe states in Northern Nigeria (the PRRINN project), as well as a project in India. Both are under the HISP action research network.

The research approach is action-oriented and described as a 'network of action' research methodology. The network of action approach is based on the principle of creating learning and innovation through multiple sites of action and use, and sharing these experiences vertically and horizontally in the network. The HISP sites were in Nigeria, India and Oslo (where the researchers are affiliated).

The conceptual approach used here is related to scaling, particularly how mobiles can help scale the logic of computer-based HMIS to the lowest levels, which are characteristically resource-poor.

Findings

The paper reports on successes and challenges with the mobile-supported HMIS designed and implemented at the research (project) setting. Specifically, the mobile solution developed and deployed, a Java-based mobile forms application is described, and the contextual factors considered in its design are elaborated.

The paper reports that there is rapid adoption in the implementing sites due to the individual acceptance and immediate familiarity of participants (health facility and district staff) with the application, as many users own and frequently use personal mobiles, which they already perceived as a potential tool for HMIS data collection and dissemination. However, it also finds that beyond the mobile phone as a standalone device, there is an important institutional and socio-technical context. For example, the paper forms and registers that are summarized and reported using the phone

application need to be made available (supplied) and filled in by many workers, thus requiring mutual understanding and coordination at the level of the organization (the health facility) as well as at the level of the ministry of health. There are also the mobile companies, the servers at the state level, and the established practices and logics in the different organizations, which are all required to align and support the adoption and institutionalization of the mobile phone use. There were also new routines and requirements such as charging facilities (electricity supply/storage), on-time technical support, network coverage, scheduling mobile submissions to the server, etc. that needed to work. The paper thus suggests that mobile applications need to be sensitively designed, and introduced with an understanding of the socio-technical (and institutional) factors, that can lead to successful implementation of mobile-supported HMIS in low resource settings.

Contribution to broad thesis aim: In relation to logics, though not explicitly using the concept of institutional logics (as by that time I had not adopted the conceptual framework), this paper appears to have called attention to some underlying logics at play. It showed how the mobile data collection implementation was guided by the logics of scalability (need for universal coverage), sustainability, primary health care (grassroots focus), and the logic for context appropriateness (usability within the infrastructural context).

In sum, the paper contributes to the literature as one of the earliest papers to report on a significant phenomenon, the emergence of mobile-supported information systems, and the role of context and institutional arrangement in the institutionalization of such systems for routine data collection, if data is to successfully routinely flow from the lowest levels to the national level. In doing so, it contributes to the discourse on how national health information systems can scale to the lower levels and how mobile technology is supporting the collection, and handling of data.

My role in writing the paper was a leading one. The co-author (my supervisor) and I were both actively involved in the research documented.

Paper 4 - Asangansi I, MacLeod B, Meremikwu M, Iwara A, Roberge D, Hartsock B, Mboti I. (2013) Improving the Routine HMIS in Nigeria through Mobile Technology for Community Data Collection (*Full paper is in thesis appendix*)

Problem: Decision makers in many developing countries lack the required data needed for evidence-based health management. One reason for this is that the routine national health management information systems (HMIS) in many developing countries do not scale to the 'last mile', that is, the communities and the informal setting of villages, where a significant proportion of health-related events occur. This is mostly because community-based HMIS data collection is difficult and often either poorly done, or is non-existent, in low resource settings. Efforts at establishing community-based HMIS in the past have often failed, or at best become dysfunctional, beset by challenges with supporting infrastructure such as erratic power supply, poor road transportation and poor telecommunication. However, the recent rapid progress in the mobile industry, with the increased mobile penetration in the villages, provides an imperative to re-envision HMIS data collection in a way that addresses some of the data collection challenges at the community level. Already, early pilot demonstrations of mobile technology for health-related activities (mHealth) have successfully demonstrated their potential in

many different ways (World Health Organization, 2011). Nonetheless, most of these pilot demonstrations are generally small pilots with little impact and “often sit outside of the broader government-led district health information systems”, that is, not within institutionalized settings such as the MoHs and the HMIS (Mechael et al., 2010, p. 13). Moreover, mHealth practice and research has been mostly technical and computer science oriented, with too little evidence-generating investigation within the broader institutional public health setting (Mechael et al., 2010). Accordingly, researchers have emphasized the need to understand the possible mechanisms as well as strategies through which mHealth can improve core public health information systems at the level of the community, and by extension, the larger district-based national HMIS (Free et al., 2013; Mechael et al., 2010; Whittaker, 2012).

The research question/aim, in line with this was thus: Can mobile technology reduce the complexity of community data collection for state and national health management information systems? And, if yes, by what specific mechanisms? And what are the associated challenges and implications of mobile data collection, and are there any opportunities for future research?

The setting for the research was Cross River state in Southern Nigeria, and was conducted within the NEHSI project (earlier discussed in chapter 2).

Method/approach: The research used an implementation research approach founded on participatory action research, where we, as researchers, were directly involved in iteratively designing and implementing organizational change (the information system design and implementation), in collaboration with the stakeholders in the organization (Davison et al., 2004; McKay and Marshall, 2001; Susman and Evered, 1978). It involved the implementation of a district based health information system with mobile data collection applications, which were used to collect health and demographic data from households and individuals in villages visited by community health worker (see figure below).

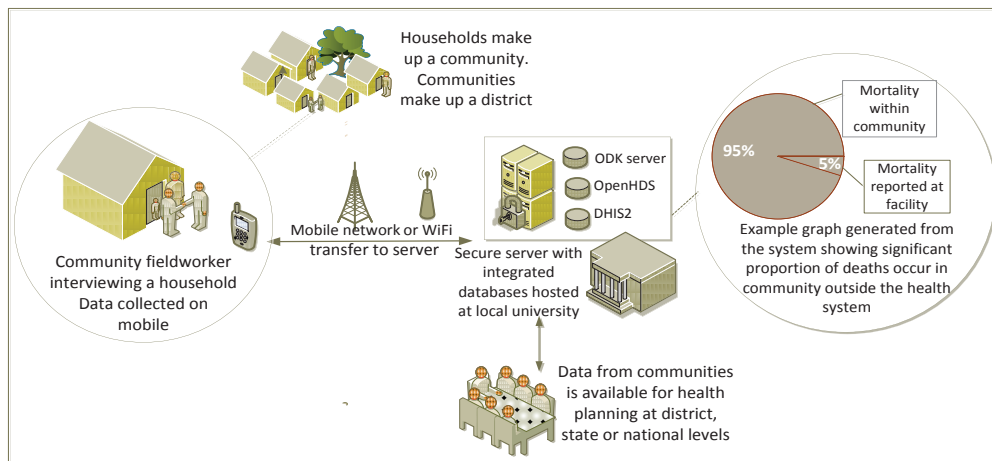


Figure 5.2. Illustration of the key aspects and concepts of mobile-supported community data collection for the HMIS

Findings: This paper documents the exploration of the use of mobile technologies to support the computer-based HMIS logic. It describes the scaling of the HMIS to the lowest levels of the health system, using mobile phones, in the setting of villages and households in Southern Nigeria. Specifically, it conceptualizes organizational mechanisms by which this mobile-supported HMIS scaling occurs. These include: facilitating savings in organizational resources, significantly increasing information quality, improving organizational efficiency (in a way mHealth technology serves as an occasion to restructure) and lastly, by helping to create new possibilities for institutionalized HMIS data collection. The paper also points to emerging challenges and areas for further research.

Contribution to broad thesis aim: With regard to exploring institutional logics, the case in this paper exposes some underlying logics at play within HMIS implementation (though the paper did not explicitly call them institutional logics nor used the institutional logics framework). It can be seen in the paper, the logics of scalability, paper-based logic, the logics of efficiency and the managerial logic. It can also be discerned the logic of using automation (computer-based logic) to improve HMIS operations and how **mobile** adoption reduces cost, improves data quality, improves decentralization of decision-making, and fosters the HMIS' appropriateness to context. It conceptualizes organizational mechanisms by which this mobile support for scaling the computer-based HMIS logic occurs.

My role in paper: I led the writing of the paper. All authors were actively involved in the project, and helped review multiple iterations of the paper.

Paper 5 - Asangansi IE, Shaguy J. (2009) Complex Dynamics in the socio-technical infrastructure: The Case of the Nigerian Health Management Information System. Proceedings of the IFIP 10th International Conference on Social Implications of Computers in Developing Countries, Dubai, May 2009. (Full paper is in thesis appendix)

This paper was my first and 'early PhD scoping' paper that contributed to my understanding of the empirical research context.

The problem this paper addresses is the failure of the Nigerian HMIS over the years, pointing out how it has failed to provide the much-needed information to guide decision-making and planning. It then discusses how the problem is linked to socio-technical complexity and is being addressed by the introduction of a new computer-based HMIS. The paper meets the need to achieve understanding and deep insight into the institutional complexity of the system and its setting.

The paper's research aim can be summarized as: exploring the institutional context and complexity of the Nigerian HMIS, especially focusing on the institutional arrangements.

The concepts applied mainly relate to institutional complexity as due to heterogeneity, evolution, the socio-technical nature and the installed base, which consists of the paper-based system and the policies that enacted them.

The empirical setting is in the Nigerian National HMIS. The level of analysis is macro (national level) but also including sub national and local level implications.

The research approach adopted involves a qualitative case study of the national HMIS, and is based on participant observation and document analysis. It is set in events leading to the long-term action

research project, the Health Information Systems Program (HISP), and the introduction of its software, the District Health Information System (DHIS) to Nigeria.

The findings are varied: The paper exposes the historical context and dynamics of the National HMIS; detailing its evolution and socio-technical aspects. The paper-based system and the changes in policies are described as the installed base on which the computer-based system is built. Thus it tightly links the assumedly technical HMIS to health policy and socio-political factors and, through this, emphasizes the role of institutional factors that otherwise would have seemed external and inconsequential to a typical HMIS department.

In essence, the paper explores and trails the organizational context (through many decades) up to the emergence of the DHIS-based National HMIS, and describes its heterogeneous make-up as a complex socio-technical infrastructure.

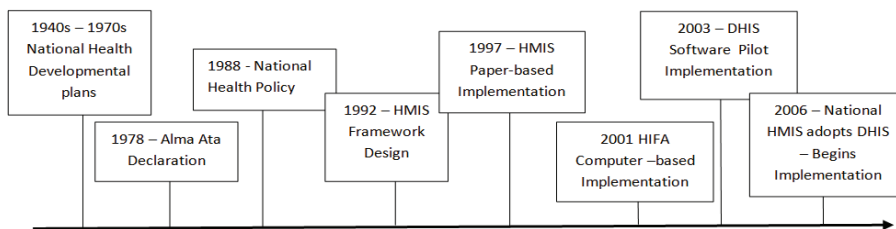


Figure 5.3. Timeline showing key events in the development of the Nigerian HMIS

Particularly, the context is exposed as being heterogeneous as the HMIS consists of numerous health-related workers and institutional actors at federal, state, district and health facility levels; the HMIS datasets and forms; the processes (data collection, processing, analysis, dissemination, interpretation, use, feedback); and tools (paper forms, reports and the DHIS) as well as the complexity of interactions between these multiple components.

Contribution of paper to broad thesis aim: With respect to institutional logics, reanalyzing this paper, though not explicitly using the concept of institutional logics, the paper highlighted some underlying logics at play. It highlighted how the logic of socioeconomic development, underlies the rationale for HMIS automation for efficiency (computer-based logic). It also highlights the role of important institutional factors such as political buy-in, military rule (as deterrent to the logic of democracy), economic logic of free & open source software, democratization (logic of democracy) linked with the logic of universal access (primary health care philosophy), political decentralization, the strive to meet the Millennium Development Goals, etc., in shaping the adoption and evolution of the Nigerian HMIS. It also described how the sustainability logic of the HMIS by illustrating how failure resulted from pullout of international funders.

As such, other authors (e.g. (Anifalaje, 2012)) have quoted the paper as a summary of the social infrastructure and institutional arrangement of the Nigerian HMIS. It was particularly useful for me as an ‘early PhD paper’ that laid the foundation for my process of understanding and constructing meanings about the HMIS both at national as well as state, district, health facility and community levels.

My role in this paper was a leading one. I led the collection and analysis of the data as well as the writing of the paper. My co-author was fully involved as well, reviewed drafts of the paper, and gave insight, especially as he had been involved in the thick of the Nigerian HMIS and in HISP (Nigeria) for more than three years before I joined.

5.2 Summary

So far, this chapter has presented a summary of findings from the research papers. In this subsection, we summarize the papers using two tables (tables 5.2 and 5.3).

The first table (table 5.2) below shows a comparison of the two cases in this thesis, highlighting the logics that they each illustrate. Looking at the two empirical cases, both of them contributed differently to the understanding of logics. Generally, case 1 showed more of the logics, and I think may be so because I spent much more time with staff from the Ministry of Health and funders than in Case 2. However, some of the logics are overlapping i.e. can be found in both cases, as can be seen in the table 5.2 – in fact, paper 2 is based on two of such common logics (network and hierarchy) which influenced both implementations.

Table 5.2 Summary of both HMIS projects, the papers involved and the logics they presented. This builds on (extends) table 2.3.

Cases	States & Period	Key actors	Goal	Institutional Logics
Case 1 – PRRINN HMIS project	Katsina state (also Yobe state minimally) 2009 - 2012	The PRRINN project, DFID (funder), state and local (district) governments, national and state HMIS offices, health facility workers, technical implementers (HISP)	Improve reporting of health data from health facilities to HMIS (DHIS)	Paper 1 - Short-term project-centric logic, long-term infrastructure building, scalability, universal coverage, decentralization and centralization logics , network logic, hierarchy logic, performance logic, ownership logic, sustainability logic Paper 2 - Network logic, hierarchy logic, automation Paper 5 - Economic (sustainability) logic, logic of open source philosophy, decentralization, computer-based (automation) logic Paper 3 Scalability logic, context-appropriateness, automation logic
Case 2 – NEHSI HMIS project	Cross River state 2010 - 2012	NEHSI project, IDRC (funder), state and local (district) governments, Universities of Calabar & Southern Maine, national and state HMIS offices, community health workers	Improve reporting of health and demographic data from communities to the HMIS (DHIS)	Paper 2 Network logic, hierarchy logic, automation Paper 4 data quality logic, economic logic, computer-based (automation) logic, context-appropriateness, universal coverage (scalability) logic

The second table below (table 5.3) draws attention to how each paper’s research aim/question and theoretical construct link to this thesis’ overall aim and three research questions (RQ 1-3 outlined in the introductory chapter).

Table 5.3. Summary of empirical settings, levels of analysis, paper’s research aims, and linkage to thesis’ three research questions/aims.

Paper	Empirical setting, research design and level of analysis	Paper’s research aim/question	Theoretical constructs	Aspect of thesis’ research questions paper addresses
1	PRRINN HMIS project (Katsina) Action research Level: Meso (the project and organizations involved) & Micro (individual)	What institutional logics were involved in the HMIS implementation and how they influenced the trajectory? How the HMIS implementation was influenced by the dominant logics	Institutional logics: Short-term project-centric logic, long-term infrastructure building, scalability, universal coverage, decentralization and centralization logics , network logic, hierarchy logic, performance logic, ownership logic, sustainability logic	RQ1 (HMIS institutional logics framework)
			Conflicting logics	RQ2 (complexity due to conflicting logics, power struggles)
			Paper proposed transitional and dialectical resolution	RQ3 (implementation tension resolution)
2	PRRINN & NEHSI HMIS projects action research Level: Meso (project and organizations) and micro (individuals)	Is mHealth Disrupting the Status Quo? Evidence from Implementations Highlighting Network vs. Hierarchical Institutional Logics	Institutional logics: Network logic, hierarchy logic, automation logic	RQ1 (HMIS institutional logics framework)
			Conflicting logics (network vs. hierarchy)	RQ2 (complexity due to conflicting logics, power struggles)
			Concept of dialectical resolution	RQ3 (implementation tension resolution)
3	PRRINN HMIS Action research Level: Meso (the project and organizations involved)	Exploring how mobiles help scale the HMIS to the lower level (health facilities) i.e. scalability of the HMIS	Logics: Scalability, context-appropriateness, automation	RQ1 (HMIS institutional logics framework).
4	NEHSI (Cross river state) Action research Level: Meso (project and organizations) and micro (individuals)	Exploring organizational mechanisms by which mHealth data collection scales the HMIS to the most remote villages/communities i.e. scaling the computer-based logic	data quality, context-appropriateness, universal coverage (scalability) logic, economic logic, computer-based (automation) logic,	RQ1 (HMIS institutional logics framework)

5	Nigerian national HMIS.	Understanding the socio-technical infrastructure and institutional complexity of the HMIS	Logics: Economic (sustainability) logic, logic of open source philosophy, decentralization, computer-based (automation) logic	RQ1 (institutional logics framework)
	Document analyses, Participant observation		Level: macro (national)	multiplicity, heterogeneity, Historical embeddedness and dynamics of HMIS (historicity)

(PRRINN states – Northern Nigeria; NEHSI – Southern Nigeria)

The next chapter synthesizes the findings in the papers and the theoretical aspects, discusses their implications, and highlights the overall contributions (practical and theoretical) that the thesis makes.

CHAPTER 6: CONTRIBUTIONS

6.1 Overview

The aim of this research has been to improve our understanding of HMIS implementation and its complexity. A perspective based on the concept of institutional logics was adopted, and the following research questions were developed to guide the research:

- **Research question 1 (RQ1): How do institutional logics and their interplay influence and shape the HMIS implementation process?**
- **Research question 2 (RQ2): How do institutional logics help us understand the complexity of HMIS implementation?**
- **Research question 3 (RQ3): What are alternative approaches to resolving conflicts within existing logics?**

In this chapter, the focus is on the theoretical and practical contributions made through addressing the posed research questions. Using the useful perspective by Walsham (2006) for framing and understanding contributions from interpretive research of this nature, I indicate the **target literature; proposed audience(s); theoretical contributions; and practical contributions of the research.**

For this research, the **primary target literature** is the literature on HMIS in developing countries. The **secondary target literature** is the literature on organizational research into information systems (IS): since HMIS is a subset of IS as a whole. Accordingly, the **proposed audience** for this study is broad: involving the researchers and practitioners in aforementioned primary and secondary literature domains. Concerning **theoretical and practical contributions**, I have identified six key contributions, which are linked to the research questions as demonstrated in the box below.

<p>Theoretical contributions</p> <p>Contribution 1. HMIS institutional logics framework (RQ 1)</p> <p>Contribution 2. Institutional complexity framework (RQ 2)</p> <p>Contribution 3. Implementation tensions resolution framework (RQ 3)</p> <p>Practical contributions</p> <p>Contribution 4. Direct contribution to the setting through the action research</p> <p>Contribution 5 & 6. Implications for practice</p> <ul style="list-style-type: none">a. Institutional perspective to mHMIS/HMIS (RQ1, 2 & 3)b. Managing the Complexity of the Implementation process (based on RQ1 & 2)

Figure 6.1. List of theoretical and practical contributions - with mention of associated research question (RQ)

Before exploring these contributions in detail, it is helpful to show how the papers have contributed in addressing the research questions; also how they are linked to the contributions. It is to be noted that

though not all the papers explicitly use institutional logics as a framework, they all essentially indicate or explore one or more important institutional logics and key aspects of institutional complexity. Specifically, papers 1 and 2 explicitly used an institutional logics lens, while papers 3, 4, and 5 did not use this lens but had their data re-examined in the light of the overall institutional logics perspective adopted for this thesis.

It is important to note that in the following discussion in this chapter, logics include both society-level logics (e.g., capitalism, corporate bureaucracy, democracy, profession and family) as well as sub-logics (e.g., objectives derived from the society level logics but at the lower level of the organization and project). The papers have contributed to understanding the role of logics at both levels – some at the higher societal level and others at sub-logic level (at the level of organization and project). Table 6.1 below is a paper-based illustration of the logics (and sub-logics). Later in table 6.2, I delineate the top society-level logics from the sub-logics enacted in the organization/project.

Table 6.1. Overview of how the papers contribute in addressing the research questions. (Since some papers did not explicitly use institutional logics, their data had to be re-examined in that perspective)

RQ	Papers	Contribution
RQ1 What (and how do) institutional logics guide and shape HMIS implementation?	1	Short-term project-centric logic, long-term infrastructure building, scalability, universal coverage, decentralization and centralization logics , network logic, hierarchy logic, performance logic, ownership logic, sustainability logic
	2	Network logic, hierarchy logic, automation logic
	3	Scalability logic, context-appropriateness, automation logic
	4	Data quality logic, economic logic, computer-based (automation) logic, context-appropriateness, universal coverage (scalability) logic
	5	Economic (sustainability) logic, logic of open source philosophy, decentralization, computer-based (automation) logic
RQ2 How do these logics help us understand HMIS implementation complexity?	Papers 3 – 5 (data reviewed)	Institutional complexity - Multiplicity/heterogeneity, complex identity, historical contingency
	Papers 1 – 2	Institutional complexity – conflicting logics
	Paper 2	Institutional complexity - Power and disruption.
RQ3 What are alternative approaches to resolving conflict within existing logics?	Paper 1	Complexity – 3 mechanisms of resolving conflicting logics – deinstitutionalization, changeover (transitional) resolution, dialectical resolution

As shown in table 6.1, research question 1 relates to identifying the logics and how they influenced the implementation. The logics identified in the five papers have been synthesized into an **HMIS institutional logics framework (contribution 1)**. Table 6.1 above also demonstrates how papers 3, 4, and 5 contribute insights on multiplicity/heterogeneity, historical contingency, and complex identity. The later term is not used explicitly in the papers but is proposed (after re-examination of the data associated with papers 3, 4, and 5 during the writing of this thesis) as a way of understanding some of the empirical material. Paper 1 (Asangansi, 2012) and Paper 2 (Asangansi, forthcoming) contribute to our understanding of complexity as conflicting logics. I have integrated these concepts into an

institutional complexity framework (contribution 2). By exploring how conflicting logics are resolved, Paper 4 contributes to the construction of an **implementation tensions resolution framework (contribution 3)** that I have proposed to help us better understand the alternative ways how conflicts get handled in project implementations. These three conceptual frameworks form the bulk of the discussion in the theoretical contributions section of this chapter. I have used the word ‘framework’ here as a way to delineate these 3 groups of inter-related concepts that have been explored and conjectured in this exploratory research. They are not theories but rather a way to name and frame the three theoretical contributions of this research.

The rest of this chapter is structured in four main sections: the next section discusses the theoretical contributions listed above; the second section highlights the practical contributions; the third section presents the potential areas for further research; and the last section provides concluding remarks.

6.2 Theoretical Contributions

Before going into details, I present table 6.2 which provide an overview of the three theoretical contributions. Particularly, I list the conceptions developed and the components within each of the contributions.

Table 6.2. Summary of details of the three theoretical contributions.

	Contribution	Some details on composition of the contribution e.g. concepts in framework
1	HMIS institutional logics framework	Identified society level logics of HMIS (adapted from literature and applied to HMIS): bureaucracy, economy, efficiency, hierarchy and profession Equivalent metaphors for the logics: HMIS as business investment; HMIS as machine; HMIS as empowerment; HMIS as political hierarchy; HMIS as technology Sub-logics (lower-level objectives based on the society-level logics. They are derived from the empirical material): Automation (computer-based logic), sustainability, open source philosophy, project management logic, data quality logic, vertical approach logic, primary health care logic, universal coverage logic and need for scale (scalability logic), long-term infrastructure building logic, network logic, hierarchy logic, technological performance logic
2	Institutional complexity framework	2a. Multiplicity of logics & heterogeneity of participants; 2b. Complex identity (HMIS as composite identity & logic); 2c. Historical contingency (installed base) of HMIS; 2d. Power struggles; 2e. Conflicting institutional logics
3	Implementation tensions resolution framework	3a. Deinstitutionalization, 3b. Transitional (changeover) resolution, 3c. Dialectical resolution (3a is adapted from existing literature; I have developed and proposed 3b and 3c in this thesis.)

It is important to state here that some of the components of these frameworks are not new. Those that are new additions from this work are identified. However, the key contribution is the combination and synthesis of related literature with new concepts and interpretations - I have proposed from my empirical material - to form these three new frameworks that increase our understanding of the various aspects of HMIS implementation from an institutional perspective.

6.2.1 Contribution 1: HMIS Institutional logics Framework

As we discussed in the conceptual framework, I have drawn on the work of Friedland and Alford (1991) and Thornton et al. (2012). According to these studies, society as a whole is influenced and structured by the broad society level institutional logics (or sometimes called institutional orders) such as capitalism, corporate bureaucracy, democracy, profession, and family.

I have made the assumption (backed by data) that this applies to the HMIS; therefore, I adopted this as a structure to view the institutional logics of the HMIS. To the best of my knowledge, as of yet no other work has applied the inter-institutional system to understand the HMIS. Hence, this is a valid contribution by itself. Understanding institutional logics is one of the core challenges for HMIS research (Sahay et al., 2010), particularly considering the complexity of developing implementation strategies, which involve the multiple and varied participants that often engage in the HMIS implementation process. The empirical exploration and descriptions, especially through the papers in this thesis, have shed interesting insights into these logics of the HMIS. These explorations highlight how the institutional logics in society influence and are inscribed (through participants) into the HMIS implementation process.

The key institutions and society-level logics (based on (Friedland and Alford, 1991)) used in this research work¹ include economic logic (capitalist market), bureaucracy (efficiency and hierarchical logics), state (empowerment logic of social democracy) and profession (HMIS technology in this case). These well-known society level logics are explored from a HMIS perspective, with a short discussion on the sub-logics they spurn, as I found in my empirical data.

Economic logic (capitalist market)

In this logic, the HMIS is seen as a financial investment with its relevance being in providing key performance and background information on the investments into the health system as a whole. Getting value for the money spent on HMIS is important; the return on investment (ROI) is not necessarily monetary but information – as tangible marketable information reports, etc. terms such as ‘value for money’ and ROI are often used within this logic.

As an example, the PRRINN guidance document from their funder, the DFID clearly highlights the focus on value for money – see box 6.1 and figure 6.2 below.

¹ I have excluded two society-level institutional logics mentioned by Friedland and Alford (1991)– religion and family – because I did not find correlates in my data.

“value for money in DFID’s programme means: we maximise the impact of each pound spent to improve poor people’s lives... we have a particular duty to show that we are achieving value for every pound of UK taxpayers”

Box 6.1. Statement from (Operational Plan 2011-2015 DFID Nigeria (DFID, 2012)

DFID's Approach to Value for Money (VfM)	
Department for International Development	
July 2011	
Contents	
Top-line messages.....	2
1. VfM Principles.....	3
Figure 1: DFID's 3Es Framework.....	4
2. How we ensure Value for Money in our Aid Programme.....	9
Figure 2: DFID Results & VfM Framework.....	9
3. What this means for you.....	9

Figure 6.2 Cover page of a document on the principles guiding PRRINN’s work (funded by DFID)

The data above shows the typical focus on producing tangible ‘showcase-able’ results within a time frame. The time bound nature of the funding thus puts pressure on the HMIS implementation, in a way that short term results and quick wins are sought unsurprisingly at the peril of long term infrastructure building. As one of the Katsina PRRINN officers once said during a planning meeting,

“Please let’s focus our planning only on what we can quickly achieve within this time frame. You know our budgeting is till 2012. Before that time we have to get evaluation reports to the office, which will then send to the UK showing what we have achieved. And (it) is based on this that we will get more funding. Please consider this timing as you are thinking.”

This logic is an important one for HMIS sustainability because when funders withdraw funding, as was shown in the discussion of the Nigerian HMIS (as in paper 1), projects fail.

We also see that the economic logic influenced the decision to adopt the free and open source HMIS software (DHIS), as open source is assumed to lead to lower total cost of ownership. As the national HMIS officer once emphasized;

“Why spend so much on HMIS software when we can get it for free? We have many software sellers coming to our office to market all sorts of packages but the DHIS is free.”

Also, we see (in paper 4) that one of the mechanisms and rationales for adopting mobile data collection is to reduce the significant financial cost for implementing community-based HMIS. In the ways mentioned, the economic logic influences HMIS implementation through the sub-logics of focused (cost- and time-limited) HMIS project management (results need to be achieved quickly), the need for financial sustainability, free and open source software adoption, and the automation logic (adoption of the mobile data collection approach to HMIS).

Bureaucracy (efficiency and hierarchical logics)

The HMIS department and the MoH as a whole can be viewed as a corporate bureaucracy (see paper 1 and 2), and there are two logics related to this: the logic of efficiency and the logic of hierarchy. Efficiency logic

The efficiency logic sees the HMIS as a machine that is meant to produce statistical reports and periodicals. Based on this, the implementation of a computer-based system is seen as an automation process to improve the efficiency of data collection and processing. However, the influence on the HMIS is similar to that on a production line of a factory – there is a focus on the machinery for timely report production as well as the product quality: data quality in the HMIS case (as we see in paper 4, where the mobile application efforts are mostly focused on engineering efforts to prevent errors and produce timely, complete and correct reports).

A short conversation with a project manager at the NEHSI project is quite instructive:

Me: How do you manage to coordinate the data collection from thousands of households in Akpabuyo?

Program manager: Well, we work hard and try to be organized and disciplined. We put effort to make everybody stay in line. If someone messes up, we can all be messed up. You know, it's a factory here. We have two departments: the field system and the data system; each has standard procedure. These two are interwoven, as one cannot function optimally without the other. The field produces the raw data; then our data system here does the cleaning, analysis and generation of the reports: the finished goods.

In addition, this efficiency logic relates to a tendency for micromanaging projects, such that each part of the process is specialized (as in a typical factory). In this research, I found that this is manifested as the vertical (scope-limited) approach to the HMIS, where the focus is made to one disease or program area. Particularly, this has an influence that attempts are made to tune HMIS projects like machines; for example, the project could be made to focus on a small scale or one program (say malaria) at a time. This often conflicts with a broad view of HMIS where the focus is horizontal and all aspects/diseases are considered. An example here is discussed in paper 1, where the NGO's focus on only one disease and few areas was in conflict with the state's interest in the general health of the people:

“The implementation needs to involve all the districts, health facilities and all aspects of the HMIS, and not just collecting immunization data in a few selected sites.” (Katsina state ministry of health manager)

Hierarchical Logic

Bureaucracies, like the HMIS, are also **hierarchical**. The HMIS is organized in a reporting chain that runs from the community to the facility, to the district, to the state, to the national level. The status of individuals in such hierarchy appears linked to their level in the chain. For example, the information workers in the health facilities (e.g. data clerks) are considered 'lower' than and 'junior' to those at the districts and state (e.g. the state HMIS officers). The amount of data one handles becomes a symbol of authority. Those at the top (or the center) have more data and make more decisions. One influence that this has is that decision-making is often centralized in this logic and may conflict with the logic of decentralization, which is encouraged in the emancipatory view of public health. This tension between centralization and decentralization continues to play out in the Nigerian HMIS as policy and resources mostly come from the center, the national and state levels, down to lower levels such as facilities and

districts who are often too weak to exert influence or function properly, as such decision-making remains largely top-down.

Social democracy (Empowerment logic)

The empowerment logic is based on the principle of social democracy; it underlies the primary health care philosophy, which is the foundation of the Nigerian HMIS. This philosophy advocates for universal coverage for all citizens (as in the popular slogan 'health for all'). It also mandates equitable distribution and access to health resources, participation and ownership by communities, and pushes the view that health is a human right (social justice). In this study, I found that this translates in the HMIS to the logics for universal HMIS coverage and consequently to a HMIS that is under pressure to scale to the grassroots (scalability logic). It translates to the logics of local ownership, local contextual appropriateness, decentralization, and the logic of long-term infrastructure building for citizens (where the focus should be on not just quick wins but on improving underlying facilities and infrastructures of the HMIS, for the long term). Some of the quotes from this research that exemplify this logic:

Alma Ata declaration of 1978:

Health "is a fundamental human right"
It is a "most important world-wide social goal"
"Governments have the responsibility"

Health manager at Katsina state ministry:

"The implementation needs to involve all the districts, health facilities and all aspects of the HMIS, and not just collecting immunization data in a few selected sites." (universal coverage: everybody needs to be covered not just few people)

District officer in Katsina:

"While it is appreciated that the sentinel system is important to monitor NGO interventions, the associated data collection, flow, and analysis should be part of an overall strengthening of the monitoring capacity of the district and [entire] state, rather than as a vertical NGO immunization-focused activity".

State HMIS officers:

"We need to be able to run this system here and without your assistance, so that when the project ends we can continue to run it." (Ownership logic)

Program manager at Akpabuyo:

"The community fieldworkers are happy as we gave them mobiles. They feel more important than before. They are happy that they are able to use the latest technologies. They are happy because we are working to make their job easier....They try to use it for personal use. But we have warned them to use it strictly for collecting data. We asked them not to use the phone for calls. We even gave them airtime in their personal phones, in case they need to call...They even feel important because of the money for calls...and, you know, now the local government even gave them a free accommodation in the community...Now we are making newsletters for the communities. For the houses they go to visit. They tell them what they have collected. They like it. They are happy to know what is happening and they use it in their discussions."

Profession logic (information technology industry)

A fifth institution is the profession (in this case, technology for the HMIS), where the HMIS is seen as a craft for developing the technological artifact itself. In this logic, technology is viewed as being able to meet the goals of the HMIS. HMIS information making is seen as a product of software engineering. I found this to be obvious with attempts by the projects at replacing paper with computer, and the continued evolution of the computer-based HMIS to the 'latest' technology. Another way this influences the HMIS is through the IT industry trend towards web based technologies, or what some have described as networked technologies. The DHIS for example, as we explained in paper 4, has migrated from the desktop (MS access) based version 1 to the web-based (version 2). Many other health software artifacts such as the popular open source medical record system (OpenMRS) and open source health and demographic surveillance software (OpenHDS) have taken this route as well; it is a general trend even in basic everyday software like word processing and spreadsheets. However, this trend is helping to create network forms of organizations such that some authors have described that networked architectures like the internet and mobile networks are inscribed and embedded with a network logic. This logic of networks, as embedded in the new mobile/internet supported HMIS facilitates open communication and as discussed in paper 1 and 2, introduce some 'challenge' and disruption of the hierarchical mode of organization where communication is restricted and linear. This is discussed further in a subsequent section on conflicts as well.

Most importantly, in this logic, technological determinism thrives. A conversation with a technologist at the Akpabuyo site (NEHSI) shows this:

Me: Why is the HMIS in Cross River difficult to improve?

Respondent: The problem is lack of technical knowhow and the lack of computers and mobiles. There has been no proper training on the part of users. There is a serious gap in computer literacy. And we don't have software developers, no computer facilities in the ministry. If only we can provide all the training and all the computers and devices, we will have a perfect HMIS in this state.

(Implying that all the problems are linked to the provision of technology)

In summary, we have discussed the logics (and sub-logics) that were observed to influence the HMIS in this research.

This framework is from a combination of my data and the interpretation of that data. In discussing these logics, I want to note that the society-level logics translate to sub logics within the implementation. For example, the society-level logic of social democracy translates to primary health care, to universal coverage logic, and to scalability logic within the HMIS implementation. By showing this relationship between logics, I demonstrate the multi-level complex nature of institutional logics. This is demonstrated in table 6.3, where the columns are headed by the institutions and society-level logics. Additionally, at the bottom of the table I show the sub logics, which are the organization and project level enactment of logics. The table 6.3 (which represents the HMIS institutional logics framework); I also demonstrate (as a row in the table) how the logics confer identity. As explained previously, logics are a cognitive characteristic that members share and they help confer and build identities. The sources of legitimacy and the symbolic view by participants in each of the logics are also shown in table 6.3 below.

Table 6.3 HMIS institutional logics framework – summary and characteristics of HMIS core logics. (sub-logics are highlighted in the bottom row).

Institution	Capitalism (Market economy)	Corporate Bureaucracy		State (social democracy)	Profession (Technology)
Society-level Logics	Economic logic	Efficiency logic	Logic of hierarchy	Empowerment	Profession (IT)
Root metaphor	HMIS as business investment	HMIS as machine	HMIS as political hierarchy	HMIS as empowerment	HMIS as technology
Outcome and goal – basis of mission	Save cost, derive ‘value for money’	Periodic and timely statistical reports and periodicals (which are sometimes not used)	Ensure stability, organizational norms and power relations	Social justice (fair distribution of resources), no discrimination	Application of best or most appropriate technology
Symbolic view of HMIS Information collected	Viewed as return on investment (ROI) into HMIS. HMIS helps assess performance of health investments	Output of efficient processes (data collection machinery)	Information as product of power structure	Information is power, and should be shared	Information as product of software
Institutional actors/entrepreneurs	Funders (Donors, government) e.g. DFID, IDRC in the two cases	HMIS administrators, Project managers, management consultants, NGOs,	Data collectors in traditional MoH officials, MoH hierarchy	Elected politicians at national, state, districts	Technology consultants, HMIS-related hardware and software vendors
Sources of legitimacy	High ROI. Maximizing limited financial resources	Amount and quality of HMIS reports. Administrative routines	Loyalty, and reporting, to next HMIS level	Democratic leadership, HMIS focused on ‘poor’ people	HMIS technology expertise
Sources of identity	HMIS funder status Financial ownership	Role in improving efficiency in HMIS bureaucracy Organizational culture and norms	Role in data reporting chain. Status in hierarchy	Support for emancipatory activities – training, field work, data review and use	Reputation. Association with technologies. Technological sophistication
Sub logics (derived from society-level logics)	<ul style="list-style-type: none"> -Automation (Computer-based logic) – computer adoption to save cost (e.g. mobile adoption reduces cost in paper 4) -Sustainability after initial investment (Paper 5 – challenge after funders pull out) - cost-reduction logic (e.g. open source as cheap alternative (Paper5) -Project management logic – projects should be on budget (Paper 1) 	<ul style="list-style-type: none"> -Automation for HMIS efficiency (performance logic) (Paper 5, 4, 1) -Project centric logic (New public management) (paper 1) Focus on small scale and scope, short term projects rather than long term infrastructure -Vertical approach (Paper 1) -Data quality logic (Paper 4) 	<ul style="list-style-type: none"> -Centralization (paper 1) - Data flow hierarchy and power structure (Paper 2) 	<ul style="list-style-type: none"> -Universal coverage (equitable resource distribution) (Paper 1) -Scalability (paper 3, 4, 1) -Decentralization of decision-making Paper 5, 4, 1) -Appropriateness to context (Paper 3, 4) -Long-term building of infrastructures for citizens (paper 1) - Network logic (Paper 1, 2) -ownership logic (Paper 1) 	<ul style="list-style-type: none"> -Network logic – trend towards networked technologies such as internet & mobile (Paper 1, 2) -Automation (computer-based logic) (Paper 1,5) -Technological performance (paper 1)

6.2.2. Contribution 2: Institutional Complexity Framework: Multiplicity/Heterogeneity, Complex Identity, Historical Contingency, Power & Conflicting Institutional Logics

Research question 2 is focused on how this thesis may provide rich insights into institutional complexity, and answering it helps in exposing how the difficulty of HMIS implementation may be understood from the perspective of institutional logics.

As emphasized in the introduction section, recognizing and unpacking institutional complexity has remained one of the central issues in HMIS and IS research; and understanding complexity has been argued to be one of the fundamental steps towards developing better IS implementation strategies. This thesis gives conceptual insights to the complexity and difficulty of implementing HMIS by exposing that complexity arises from the difficulty of managing logics and navigating the multiple logics that participants bring to the process. (As discussed in chapter 3, complexity in this thesis refers to this difficulty).

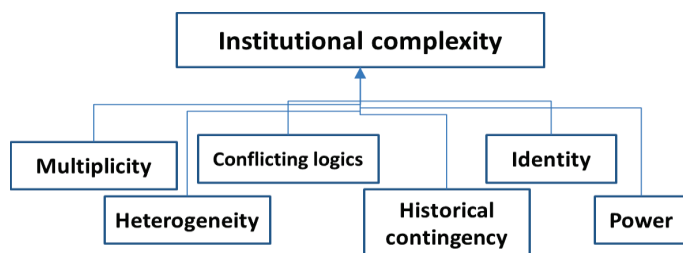


Figure 6.3. Institutional Complexity Framework

Particularly, this thesis proposes a holistic framework (see Figure 6.3 above) that may foster our understanding of HMIS implementation complexity. It proposes that such a framework may consist of the following concepts:

- The multiplicity/heterogeneity of logics,
- the complexity of identity,
- power structures
- historical contingency, and
- Institutional complexity due to conflicting logics (with the challenge of resolving these conflicts)

Such a framework for institutional complexity is lacking in the literature. This attempts to unite fragments into a whole, using my research experience.

6.2.2.1 Multiplicity and heterogeneity of logics

From the previous subsection, this empirical research shows that the HMIS is loaded with multiple logics. The sheer number and types of sub logics, the multi-level nature and the heterogeneity of actors are indicative of the complexity of the implementation process. Within the HMIS projects where I was involved, the managers had to face a landscape overloaded with logics; leading to a cognitive challenge for managers to understand fully the participants and their perspectives and viewpoints. As one manager said:

“The HMIS is so complex; when I make decisions, I have to consider so many things, and so many people. It is difficult to carry everybody along. I just finished with the HDCC (health data consultative) meeting and they were too many different ideas. Maybe the meeting is too large. Even the simple community form we are trying to make, they want to overload it.”

A quote from paper 2 of this thesis also illustrates the inclusive needed: One of the state ministry’s health managers argued that

“The implementation needs to involve all the districts, health facilities and all aspects of the HMIS, and not just collecting immunization data in a few selected sites.”

In such a setting, as can be imagined, decisions are sometimes difficult because every decision is bound to shape and be shaped by a broad range of logics. As Daudigeos et al. (2013) explain, organizational change is complex because of the multi-logical nature, which relates to the multiplicity of organizational realities that each participant brings. I posit that to understand behavior and actions in such inter-institutional systems like the HMIS is a complex task because each actor represents a different set of expectations, and individual and organizational relations and standpoints.

To display this from the data, I illustrate using the broad range of actors within the HMIS implementation, and the multiple logics that influence them (see table below).

Table 6.4 Actors in the setting, and multiple logics that guide them.

Institutional actors	Guiding logics
NGO	Economic logic, Empowerment logic
Federal/state govt MoH	Bureaucratic logic, Empowerment logic
State HMIS	HMIS as profession of care, Bureaucratic logic, Empowerment logic
District HMIS	HMIS as profession of care, Bureaucratic logic, Empowerment logic
Facility worker	HMIS as profession of care, Empowerment logic
Tech implementer (consultants)	Logic of HMIS as technology
Donors	Economic logic, Bureaucratic logic
Mobile companies	Economic logic

Table 6.5. Actors at different levels of the Nigerian HMIS

Level	Actors
Federal	Epidemiologists, information officers, elected officers, health administrators, international partners, local NGOs, consultants, researchers, program officers donor agencies, health activists, nongovernmental organizations, vendors, consultants, and politicians, Federal Ministry of Health
State	Epidemiologists, information officers, elected officers, health administrators, partners, local NGOs, consultants, researchers, State Governor and State Ministry of Health
Local government (district)	Local Monitoring and evaluation (M&E) officers (district information officers), PHC Department Officers, District head (traditional ruler), Local government chairman (elected), vertical program officers
Facility	Patients, health workers, health records officers
Community	Village/voluntary health workers (VHEWs), Junior Community Health Extension Workers (JCHEWS)

Such broad range and heterogeneity undoubtedly can lead to unpredictability and a scenario that is hard to control. In the projects, the number of players we engaged by the end of the project were much more than the number we envisaged. For example, for one of our DHIS trainings where we expected to train HMIS officers, the state's ministry of health also sent in information officers and managers from the statistics bureau, ministry of social welfare, women affairs, and more departments outside the traditional ministry of health; and each of these personnel had their own views and logics by which they thought about the HMIS. Scott (2000) also illustrates this complexity due to multiplicity of logics when he explores how the logics of market, democracy and the professional logic of medical care all combine to result in a complex landscape for health care in the US. In essence, the multiplicity and heterogeneity increase unpredictability and increases the cognitive load for HMIS projects, making the implementation process complex to navigate.

What the institutional logics approach lets us see (as different from other approaches to heterogeneity) is the cognitive aspects of the complexity and the institutional heterogeneity. It also improves on the neo-institutional approach that focuses instead on isomorphism and homogeneity (DiMaggio and Powell, 1991). By so doing, it explains why HMIS implementations and other organizational change process can be non-deterministic and complex.

6.2.2.2 Complexity of identity

Linked to the multiplicity of logics is the issue of the complex identity of the HMIS social unit. Identity is a mechanism through which institutional logics influence individuals, organizations, professions and industry (March and Olsen, 1989; Thornton and Ocasio, 2008). The identity is the cognitive, normative and emotional connection experienced by members of the group due to their perceived commonality (of logics and norms) with other members (Polletta and Jasper, 2001). However, for HMIS it can be difficult to identify a unifying identity. Using my experience in this research as an example, on many occasions, other HMIS personnel and I have been introduced at different meetings and discussions in different ways ranging from 'medical statistician', 'IT guru', 'data analyst', 'the mobile implementer' etc. The process of achieving a collective identity is a major aspect of institutionalization, and can be a long and ongoing process. Many of the HMIS officers come from different backgrounds – statistics, community health, core computer science, social work, etc., which they all bring with them to influence the HMIS. As one of the managers at the state HMIS once told me,

“The different local government (district) HMIS officers bring their own style of HMIS from where they are coming from, and we have been trying to train and retrain them. This HMIS/DHIS training is helping us by giving us a common language we can speak. We are beginning to understand our different languages also. Did you notice that I had to use statistics language to explain it him?” (He said pointing to a trainee from a district).

Such a scenario shows the complexity that comes with such diverse identities. I believe that institutionalizing the HMIS, though it currently lacks an established identity in some of the states at the initial stages, is a task that may appear difficult but requires time. I think that in this case, as the HMIS proceeded, the individuals began to identify with a somewhat collective identity. As the group matured as a social collective, by virtue of discussions and meetings together, the HMIS became gradually institutionalized and a common (albeit) composite logic was emerging for the HMIS. When this HMIS officers helped train others, e.g. at the lower level trainings at facilities (step down trainings), they were able to propagate this composite logic such that the HMIS appeared to have its own distinct (perhaps

contrived) institutional logic - one borrowed and blended from the many sources and participants involved in the entire process. In fact, according to Avgerou (2004), the HMIS is an institution of itself.

Reflecting on these, I have tried to summarize this composite logic in the table below.

Table 6.6. Composite Institutional Logic Guiding of state/district HMIS officers

HMIS Composite Logic	
Legitimacy	Reporting usable (quality) data for health ministry – HMIS as machine (efficiency logic)
Source of authority	Ministry of health makes the directives and laws (regulatory force) – HMIS as political hierarchy (hierarchy logic)
Sources of identity	Bureaucratic roles – employees follow laid down job descriptions (hierarchy logic)
Basis of norms	Employment in the HMIS and followership of organizational rules
Basis of personal authority for individuals	Status in the hierarchy (and corresponding number of people reporting to individual)
Strategy	Submit and compile as much reports as possible. Ascend in the hierarchy.
Decision Influences	Regulatory force (ministry of health) Cognitive force (what other state/district HMIS units are doing) Normative force (what the NGOs and consultants say is best practice and advice – logic of technology profession)

6.2.2.3 Historicity (historical contingency)

Another way that institutional logics contribute to the complexity of the HMIS organizational change process is their historically embedded nature. This is perhaps as obvious as the maxim about ‘teaching old dogs new tricks’. As I explained in paper 5, the HMIS has come a long way and its evolution has historically involved the health policy through many decades ago. The Nigerian HMIS has evolved from influences such as the national HMIS framework laid down in the 1980s by the then military government, where command-and-control and centralization logics were dominant. These have continued to be perceived in the operation of the HMIS today. As I demonstrated in paper 5, these logics and the health policies into which they were inscribed became the installed base upon which the centralized paper-based HMIS was built, and then this paper-based system was the installed base on which the computer-based HMIS has been built (see figure below).

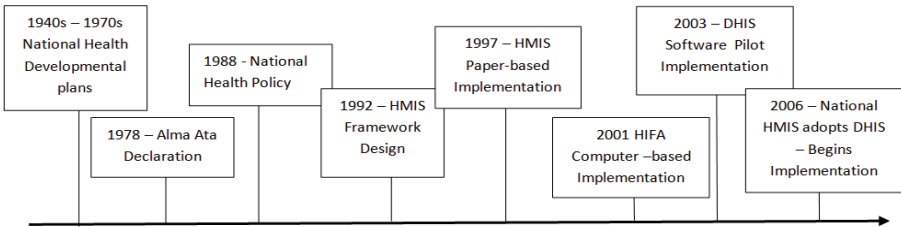


Figure 6.4. Timeline showing key events in the development of the Nigerian HMIS.

Efforts at decentralizing decision-making have yielded very little results and have been partly the motivation for strengthening the system using mobile-based tools (as in papers 1-4). Yet, it is still commonplace to hear statements like “this is how we have always done it” or the now popular lingo in Nigeria; “I am doing it exactly as my ‘oga’ (boss) at the top said it should be done.” In this way, I have seen that some of the HMIS changes we have tried to make have been subtly resisted by historically embedded logics. Another example is the training session, where we were introducing the HMIS mobile data collection app in Katsina. To the dismay of some of the enthusiastic HMIS officers (and to us, the technical implementers), the representative of the MoH announced that he wants the paper system that the ministry has used for many years to remain in place no matter how the mobile project was going to be:

“This new technology [the mobile] is good, and can help us. But we have to use it for a long time and if [it gives] no problem, we can use it alone. But for now, I say every local government must continue using the paper forms too. We will use both at the same time.” (Words in parenthesis are mine).

That meant that two parallel systems had to be run – the mobile as well as the paper-based system. Other researchers have reported this historically entrenched nature of logics, and how they result in a complex organizational change process where change is constantly contested (Mekonnen and Sahay, 2008).

6.2.2.4 Conflicting logics as implementation tensions

With the multiplicity of logics within HMIS projects, conflicts can arise when two logics offer divergent views or rationalities. They can compete for dominance, and their conflict leads to tensions in the implementation process (Thornton and Ocasio, 2008).

This research has provided empirical insights (based on the thick descriptions especially in papers 1 and 2) into how logics can interact leading to conflicts (tensions). It presented the following tensions and described how they may manifest: short-term focus vs. long-term infrastructure building; small-scale pilot approach vs. large-scale (universal) approach; vertical approach vs. horizontal (multi-system) approach; as well as tensions between ownership and performance, decentralization vs. centralization and hierarchical (bureaucratic) logic vs. open network approach. Conflicting logics lead to tensions (Thornton, 2004).

Essentially, stakeholders implementing HMIS plan to have long term impact with extensive if not universal geographical scale yet institutionalizing these changes in the involved organizations. Similarly, they aim to have quick wins, focused on places with maximum potential project impact and effecting little organizational changes, without suddenly altering institutions drastically. Understanding what is needed at the start of such a project to reach the end goal needs the kind of thinking this thesis expounds in the conceptualization of conflicting institutional logics. Implementers will need to address the tensions as questions of balance. To carry out such implementations that must have maximum impact. Achieving quick-wins yet looking towards long-term infrastructure building is a question of balancing time focus, as (Ribes and Finholt, 2009) have also explained. In the context of limited resources, a question of balancing scale is focusing on small scale within project boundaries to achieve maximum impact while considering scalability for universal coverage and the associated risk of spreading limited resources thinly. Another question of balance is limiting the scope of work to make

maximum impact, by balancing between vertical (limited scope) systems and integrated (broad organizational) systems. Additionally, another question of balance is choosing between drastically disrupting old routines and reorganizing weak existing hierarchical systems or accommodating them.

However, it is worthwhile making note of a key insight from reflecting on some of these tensions. I observed that NGO project managers planned and desperately sought to deliver on the HMIS project on time, on budget, and on scope (immunization in this case). These are the usual goals of project management – time, scope and budget. However, even though in the initial sentinel phase of the project they managed to control these three aspects, the project was considered not successful because it did not satisfy the logics of the client, the health ministry (whose logics were related to the need for universal scale and broad whole systems scope). However, through a change management process, project partners agreed to manage the tension by agreeing to re-focus on the logics of their client. This involved more time (it is uncompleted till date) and more budgeting (still needs funding) – which does not appear to be a success from a project management perspective. This new approach was considered a success by those I spoke with (the HMIS staff at the ministry) because it was in the direction they want. This is an interesting insight: that a successful project management process may be considered a failure, while a failed project management process that satisfies the dominant logics of participants may be considered a success. My interpretation is that success in HMIS implementation may be socially constructed and dependent on how much it aligns with the dominant logics, and how much of any conflicting logics are resolved.

Using this developed conceptualization of implementation tensions (conflicting institutional logics)², we can better understand the HMIS implementation process. We can see more clearly that the process of introducing technology as a process involving the negotiation of different logics and tensions. The conflicting institutional logics is a useful formulation of the negotiated impact of an IS implementation.

In addition, we see that conflicting institutional logics may relate to stages in the implementation process. For example, looking closely at the PRRINN case, the tensions concerning focus on scale/scope came at the early phases while the tensions relating to ownership and control seem to be come later in the process after initial benefits were demonstrated. It suggests that issues of defining focus may need to be discussed before the implementation starts; and issues of stability and control need to be preempted from the early phases. This thesis argues that intervening with information systems may require preempting such conflicting institutional logics and associated questions of balance from the very beginning.

6.2.2.5 Power

In all of these aspects discussed, i.e. multiplicity/heterogeneity, complex identity, historicity and conflicting logics, the mediating effects of power structures can be seen. As discussed in the chapter on the conceptual framework, the issue of power is wide reaching. “Power is everywhere”, everywhere humans are, Foucault (1978, p. 93) famously declared.

² Tensions and conflicting logics are interchangeable used in this thesis, and are taken to be synonyms, in agreement with Thornton’s explanation (Thornton, 2004) that conflicting logics lead to tensions in organizational change.

It is a cross cutting issue in the papers; and I hope to make it more explicit in this short subsection as I did not have the space and chance to do it in the papers. However, this thesis does not aim to do justice to a discussion on power in the HMIS because that warrants a more detailed exploration on its own. That said, institutional logics can be viewed as “bases of power”, especially as they “delineate what does, and what does not count” (Misangyi et al., 2008). When a group of individuals or an organization delineates their guiding philosophy, in essence, they also suggest (whether explicitly or subtly) what they will oppose. For example, when the ministry outlines its focus on the entire spectrum of health issues in the country, it is obvious that there is likely to be tensions with funders and NGOs whose guiding philosophy may tend towards streamline projects, as was seen in paper 1. Paper 1, in discussing the tensions, highlights decentralization-centralization tensions and the power struggles between the periphery and the center; the tension between the NGO, the government over mind share in the decisions relating to the HMIS implementation.

Paper 2 particularly highlights the hierarchical logic, where authority is top-down, as well as the network logic where authority is distributed. During my fieldwork, I also noticed the symbolic nature of the cost of the device, as I worked in the NEHSI project (paper 4). Essentially, I observed how the device in use varies across levels and reflects power structure: the field workers use smaller mobile phones; the supervisors use the tablet devices; while the data managers use laptops and netbooks. This arrangement was particularly also interesting because the distribution showed how the authority or power was related to the distribution of resources; despite running contrary to the technical design, where the field workers were planned to be using tablet devices. One of the supervisors had this to say, “We were not so comfortable with giving the field workers the tablet. We are in a better position to take better care of them.”

Moreover, some of the health facilities information officers in Katsina also reported that the phones given to them were taken by the heads of their respective health facilities. This implies that the hierarchical logic mediates ownership and control in those settings.

In sum, this short discussion shows logics as bases of power, how mobile devices can be symbols of power and how logics can be used as proxy for control in social situations.

In brief, using reflections on the research this subsection on institutional complexity has exposed some ways in which institutional logics play a role in the complexity of the organizational change process in HMIS implementation. Truly, studying logics needs to be emphasized. If we are to understand implementations involving the multiplicity of actors and interests, we need to understand their logics. And we need to know the way they shape the implementation process, and the effects they have in making the process a complex one.

6.2.3 Contribution 3: Implementation Tensions Resolution Framework - Resolving conflicts in institutional logics

So, how are conflicting logics handled? In this thesis, I conceptualize strategies for the resolution of conflicting logics, by outlining 3 possible mechanisms: a) deinstitutionalization, b) transitional (transient) resolution and c) dialectical resolution (discussed in details in paper IV).

Table 6.7. Three strategies for handling conflicting institutional logics

Deinstitutionalization	Transitional (changeover) resolution	Dialectical resolution
When one logic needs to be obliterated, to give way to a new logic. Example is as in (Sahay et al., 2010) where the paper based HMIS logic gives way to the computer-based HMIS logic	When actors need to focus on one logic, and compromise the other temporarily (not necessarily obliterate it) (Examples as discussed below and illustrated in table 6.5 below)	The conflicting logics need to be both adopted and combined/blended within the implementation. (Examples as in table 6.5 below)

3a Deinstitutionalization: Understanding resolution strategies is one of the major concerns for current institutional logics literature, and one that researchers have called for more emphasis (refs). Existing research mostly point to deinstitutionalization as the main resolution mechanism; and it involves replacing one logic with the other (Sahay et al., 2010). Some researchers (Hensmans, 2003; Hoffman, 1999) contend that competing/conflicting logics are usually resolved through competition, and that one logic wins the other. However, insights from this research show that there are alternative mechanisms through which competing/conflicting logics get resolved. That is, sometimes conflicting logics is not as straightforward as de-instituting one logic, and instituting another. Using my empirical material, I have proposed two other mechanisms: **transitional resolution**, and **dialectical resolution**.

3b Transitional Resolution: Through **transitional resolution**, a project could switch between logics as the need may be, such that actors can transiently focus on one logic, and only compromise the other temporarily. For instance, our empirical data relates to how the logic of local ownership was dealt with. At the start, ownership was defined based on ownership of the data in the system even if it was externally hosted. Then after the system was working successfully, local ownership began to be defined as being physical (physical ownership of the server) and this was manifested as the ministry wanting to physical host the server. After this hosting approach failed, the actors again agreed that ownership should be defined by ownership and control of data regardless data was externally hosted in the cloud or not. Thus, the logic of ownership moved from data control to physical control and then back again to data control. The tensions between ownership as data control and ownership as physical ownership was resolved not by deinstitutionalization but by changing over the dominant logic as perceived necessary. It is still possible that things can change tomorrow, and the physical hosting at the ministry may be tried again. This relates also to a previous insight that logics and context are dynamic and contextual. A broader example may clarify this further. Historically, there have been conflicts between the logic of religion-based governance and the logic of secular governance (widely known as the separation of church and state). In looking at the example of Egypt, we can see many transient resolutions in the conflict in that country; with the dominant logics of the ruling class changing and determining the implementation and interpretations of the national constitution – islamist in the pre-Mubarak era; secular in the Mubarak era; islamist again in the Morsi (post-revolution) era, and now currently secularist in today’s military era. This is how some conflicts are resolved in projects – they are resolved without a logic undergoing complete deinstitutionalization or permanent resolution, probably because such logics are deep-seated.

3c Dialectical Resolution: Another approach to resolution is that of ‘dialectical resolution’. I use **dialectical resolution** to refer to the situation where conflicting logics are resolved through an approach

that synthesizes the competing logics into one solution rather than exterminating one for the other. Here, I adapt the concept of Hegelian dialectics as applied to organizational change i.e. that organizational change occurs through tensions and contradictions, resolved through a synthesis of competing logics. We can provide bridges between logics in a dialectical/balancing way, not necessarily exterminating one logic for another. For example, in the PRRINN case, by centralizing the mobile server management on the Internet (phase 4), the implementation decentralized access to the server, balancing and creatively combining both centralization and decentralization. The conflict was not resolved by changing from one logic to another, but rather by synthesizing both sides and finding a combinational balance. Thus, dialectical resolution involves mindfully balancing between competing logics rather than taking them as if in a black-white dichotomy. A more extensive discussion of dialectics can be gleaned from the literature (Benson, 1977; Farjoun, 2002; Koreh and Shalev, 2009; Nordheim, 2009; Seo and Creed, 2002; Van de Ven and Poole, 1995). Table 6.5 below exemplifies these strategies and the tensions involved.

Table 6.8. Tensions – Conflicting institutional logics, examples from the case and resolution strategy.

Conflicting institutional logics	Example from case	Resolution strategy	Type of resolution
Short term vs. long term	Quick win sentinel system vs. long term HMIS building	Transitioned from short term thinking to long term	Transitional resolution
Small scale vs. Universal scale	Sentinel system in only 14 facilities vs. statewide HMIS in all districts	Transitioned from sentinel system to statewide HMIS	Transitional resolution
Vertical (program) vs. horizontal (whole systems)	Immunization-focused sentinel system vs. HMIS focused on broad scope of primary health care	Transitioned from vertical immunization system to broad HMIS	Transitional resolution
Ownership vs. Performance	Locally 'owned' and (state) hosted server performed poorly, while externally hosted server performed well	Found a balance: A locally controlled but remotely hosted Internet server satisfied both local ownership and gave good performance	Dialectical resolution
Hierarchical vs. network-centric	Submissions from facilities over the mobile network bypassed the districts disrupting existing hierarchical structure	Found a balance: Bypassed district officers have access to data from facilities and have sufficient administrative rights (power) to assess/approve data for facilities under them	Dialectical resolution
Decentralization-centralization	Centralized state server vs. districts wanting to host their own server and achieve 'control' of health facilities	A balance: Centralized Internet-based server management actually helped decentralize access and control	Dialectical resolution

Also, as these conflicting institutional logics are sometimes dialectical (relating to one another), the end goal should not be an either/or or good/bad situation. Both sides of the tensions need to be considered because they could imply the level of impact the project aims to make. Thus, in articulating these tensions and the relations between them, the goal has not been prescriptive or towards defining any 'golden steps to success' but rather interpretive and expository. That is, aimed at highlighting logics and conflicts from the empirical setting, explaining them, showing how they were handled, and then conceptualizing them in a framework that improves our understanding of the implementation process.

Institutional entrepreneurs as resolution agents

These agents help resolve conflicts. They identify them and they utilize some of these mechanisms to tackle them. Beyond the examples of situations above in the cases where mechanisms are used, I have an additional one. It relates to the conflict between paper-based and computer-based logics. Essentially, the goal is to deinstitutionalize paper-based logics and institute a computer-based logic based on information for action. This is one scenario where entrepreneurs have seized the opportunity to assist this deinstitutionalization process by exploring ways in which mobile technology can extend the computer-based logic to the remotest of places. During field work, we found such a simple case where a community health worker had on his own developed a system for automating his reporting from his health facility to the district level HMIS. In his own little way, he helped solve the challenge with automating the data transfer issue.

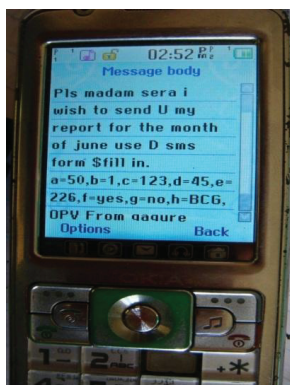


Figure 6.5 Health Facility worker developed his own electronic system (based on SMS) – a case of entrepreneurship, extending and reproducing the computer-based logic to a local work practice.

In turn, his approach fed into discussion here in Oslo, along with platforms from other institutional entrepreneurs, on how to develop SMS reporting systems. His story helped ‘drive home’ the case for mobile. Though not as a direct consequence of his approach, such SMS-based data collection systems that penetrate the remote communities are now being institutionalized in few settings, e.g., at the Nigerian office for vital registration, and in the HISP mobile project in Uganda.

6.2.4 Discussion of Further Implications

These rich insights, frameworks and concepts have theoretical implications for our target literature.

Implications for Institutional logics, institutional perspective & organizational analysis

This thesis contributes to the institutional logics literature by applying institutional logics in a new domain. By providing these insights into the dominant institutional logics in HMIS this research brings to the fore, a unique perspective (the institutional perspective) that has hitherto been poorly researched in HMIS or mHMIS in developing settings. In applying an institutional logics perspective, it validates the theoretical perspective and shows its utility as a useful approach for organizational analysis for HMIS in developing countries.

This is not to mean that there has not been much research applying new institutional theory in developing settings. This is what I really mean: previous work in the institutional literature that has applied institutional theory in developing countries (as I reviewed previously) has mostly treated the low resource context as an entity, often comparing and contrasting with the 'developed' world. In doing this comparison and contrasting, for example, studying technology transfer between two contexts (perhaps countries) or analyzing how different the developing world context and the developed context are, it appears we (researchers) have done a disservice to properly analyzing the multiple cognitive contexts of projects/organizations in low resource settings. That is, there is not just one context.

The contributions also enrich the theoretical discourse in the institutional literature by providing empirical instantiation of institutional logics and conflicting logics, and also by demonstrating empirically how institutional logics enables actors yet constrains them when logics conflict.

As previously discussed, this thesis also contributes conceptualization of resolution strategies to the literature. Research into resolution strategies for institutional logics is an identified research gap, and a major weakness in institutional logics literature, with several authors calling for more research (Reay and Hinings, 2009; Sahay et al., 2010). Also, as discussed earlier, there is a paucity of research in empirically deriving and testing the resolution approaches and strategies.

Theoretical contribution to information systems

I have some reflections on the implications of the theoretical insights and concepts but that should be considered as nuanced, not explored in detail, and should be considered as conjectures in a Kuhnian sense (Kuhn, 1962)

Understanding context - rich insights into institutional context

HMIS and mHMIS are subsets of IS, hence some of these insights and conceptual contributions to HMIS (or mHMIS) also apply to the broader field of IS. IS is an eclectic field of study with multiple influences. Over the years, Organizational analysis has proven to be a major reference discipline within IS. Thus, the contributions to the institutional perspective and the broader organizational analysis literature are of relevance as well. One strand of organizational studies influencing IS relates to the area of contextualist studies. The notion of context is one that underlies a significant proportion of information systems research; many researchers have advocated for context sensitivity in IS research (Avgerou and Cornford, 1998; Avgerou and Madon, n.d.; Avgerou, 2008; Pettigrew, 1985). It is well known that IS implementations involve difficult and complex processes that are context specific (Pettigrew, 1985). Context-specificity has become a buzzword (Bazire and Brézillon, 2005) that has become applied very often to organizational analysis of information systems. However, a major debate has been what the context is (Bazire and Brézillon, 2005; Dey, 2001). This research further explores what is meant by context (using an institutional lens) and extends our understanding of what to look out for in studying organizational contexts. This is important because there is a strong empirical and analytical argument that context is crucial when studying ICT innovations such as HMIS in developing countries. A proposition from this thesis is that institutional logics help define context. The dominant logics in a context influence and guide action, thus they become the cognitive basis (the context, if you will) for assessing and accessing reality. By this, I mean that reality for participants is defined based on their guiding logics. Thus, the understanding of logics can enrich our understanding of the context and can convey why a context is the way it is. Many times when people talk about context, they refer to

resources and physical things, especially the infrastructure and the human resources. However, this study showed that a context is much more than this. From this study, we see that context includes many aspects: the historicity³ (the linkage with what has happened in the past) and the (installed base) inertia it brings with it; infrastructural context (the components that exist); the motivations and cognition on which people in the context do things, which links up to the institutional logics dominant in the context (context as defined by prevalent logics); the technical (material) practices as well as the socially symbolic and taken-for-granted power arrangements that influence interactions. Thus, institutional logics align well with information systems research that draws on contextualism.

Understanding IS implementation as adaptive process

Understanding conflicting logics helps us understand the implementation tensions, and the tradeoffs in the implementation design as well as the adaptive process that constitutes it (Tatar, 2007). Essentially, the process of implementing an IS in an organization has been exposed as a process of adaptation between stakeholders in the process. The process of technology implementation within organizations thus involves adapting to the logics of co-participants (DiMaggio and Powell, 1983; Suchman, 1995) as accommodating their logics and norms fosters collaboration and affords the process legitimacy (Dacin et al., 2007; Suchman, 1995). Thus, through an implementation process, the technology is progressively adapted to the logics in the organizational environment and vice versa. Simply put, the implementation process is adaptive, as it demands accommodating imposing influences and logics from stakeholders in the process (Benbya and McKelvey, 2006). Information systems implementation is not an event where “one true set of requirements” is translated into technological artifacts, but rather it is a dynamic process involving embedding multiple rationalities (Benbya and McKelvey, 2006; Chiasson and Dexter, 2001). Instead of a singular organizational rationality, information system design and implementation is typified by diverse and potentially conflicting (or competing) realities that surface as the project progresses and develops, revealing the various logics of the main stakeholders (IS team, organization, users, etc.). This elaboration in diverse requirements leads not to just one but several implementation possibilities; each induced by the interests and conceptions of the various stakeholders, who eventually may be emphatic on full attention to and complete inclusion of their own rationalities and logics in the plan (Benbya and McKelvey, 2006). Consequently, the resulting IS reveals a tension between intersections of overlapping and competing sets of logics that evolve and shift as the implementation progresses. Furthermore, as the intersecting stakeholder logics continue to change, the tension and complexity increases: imposing adaptations that the implementation has to confront or deal with if it is to be successful, as well as tensions calling for navigating the IS implementation to ever emerging sets of organizational needs. When these tensions are not understood and handled, the implementation may fail (Benbya and McKelvey, 2006).

Such a perspective allows us to institutionally frame, the complex adaptive process of implementation not just as a matter of alignment and adaptations (Greenwood and Hinings, 1988) – but as a dynamic interplay of logics, all of which are set in motion by the competition between logics. In summary, the success of the adaptive process of implementations depends largely on how the ever-rising tensions or conflicting logics are resolved. The implemented system *emerges* from these tensions, and how the

³ By historicity, or historical contingency, I refer to the tendency for the context of an implementation to change over time, such that what is a valid consideration at one time is not valid at another time.

organization adapts. Such a blending of the institutional logics perspective and the complex adaptive perspective contributes to IS research, as the blending of both perspectives enriches our understanding of the implementation process.

In essence, what we think is caused by individuals and organizations disagreeing to work or to produce an integrated health information system, may have more deeply lying societal causes.

6.3 Practical Contributions & Implications

Being an action research study, this has made significant practical contributions to the setting of the projects mentioned in this study. Moreover, it has practical implications and lessons that are reusable beyond the setting of this study. This subsection discusses both kinds of practical contributions: direct practical contribution to the Nigerian HMIS through the involved projects; and practical contribution to HMIS/mHMIS implementation practice in similar settings and globally.

Practical contributions

1. Direct contribution to the setting through the action research
2. Implications for practice
 - a. Institutional perspective to mHMIS/HMIS (RQ1 & 2)
 - b. Managing the Complexity of the Implementation process (based on RQ1 & 2)

6.3.1 Direct Contribution to the setting through the action within involved projects

Through this action research, the states had the HMIS implemented for the first time, along with training and capacity building for participating individuals and state health organizations. When I started this research in 2008, the HMIS was nonfunctional in the concerned states. Consequently, state health managers were unable to monitor health activities and performance, and could not make informed health management decisions. Though the national HMIS had adopted the DHIS as national software, it was until my initial trips and the training sessions that I helped conduct and facilitate that the DHIS, the computer-based approach to HMIS was introduced in the states. As at the time of writing, I can say that the DHIS is beginning to be institutionalized i.e. the states have now established routines such as regular data reviews, supervisory activities, and regular trainings, as well as building a crop of state and district level HMIS officers.

In addition, the mHMIS approach was tested and implemented, thereby providing proof of concept for mHMIS efficacy (Asangansi et al, 2013). The national HMIS office and several practitioners in other settings also acknowledged and conceptually adopted the mHMIS approach. We have had projects in other states (and even countries) visit some of the settings in my research to learn from and re-adapt lessons to their settings. Therefore, an additional practical contribution from this perspective is the mHMIS model that we have used for mobile data collection in communities (please see more in paper 4). During the course of the study, I was also invited to national meetings to share lessons and feed into policy debates on approaches to strengthen and scale the HMIS nationwide down to the 'last mile', the communities and the informal setting of villages, where a significant proportion of health-related events occur but were largely missed.

Finally, beyond helping set up the HMIS, I observed that the information from the HMIS has made impact and direct changes in the settings involved. An example is the use of the data at the Idundu villages and environs, in Akpabuyo (Cross river state).

One of the data entry supervisors confirmed:

“When we presented the data about where the women (in the villages) deliver, the local government (district) council administration said ‘yes, this confirms what we have been suspecting’ - that people actually most of the time run away from the government-own facilities to TBAs (traditional birth attendants). The council then set up campaigns on the use of the free health facilities provided by the government based on the data we presented from the system. They are using the data. Based on the data we presented; they now understand why they have low utilization of the government facilities, and they are working on it. And in future we will follow up with more data to tell them the impact of the campaign.”

6.3.2 Implications for Practice

Looking back at the approach and setting of this research, like other context-sensitive studies, generalization from this setting has the risk of being weak or limited. However, as I showed in the papers, with numerous references to previous research, the settings for this research were typical of HMIS implementation in developing countries and low resource settings. Thus, the practical findings and the interpretations that I have made from the empirical material sit well within the framework of previous studies and the body of HMIS literature. Also, there is evidence for generalizing these such that are reusable and applicable to similar situations. Building on this, the analysis has implications not just for HMIS implementation in Nigeria but also similar contexts where conflicting institutional logics play a role in increasing project complexity.

a. Institutional perspective to mHMIS/HMIS

Particularly, this research has implications for ongoing debates on the practice of using mobile technology to support HMIS data collection. Practitioners have been concerned that most of mobile technology demonstrations are generally small pilots with little impact and that they “often sit outside of the broader government-led district health information systems”, that is, not within institutionalized settings such as the MoHs and the HMIS (Mechael et al., 2010). Moreover, it has been emphasized by researchers and practitioners that mHMIS practice and research has been mostly technical and computer science oriented, with too little evidence-generating investigation within the broader institutional public health setting (Mechael et al., 2010). Accordingly, researchers have emphasized the need to understand the institutional mechanisms as well as strategies through which mHMIS can improve core public health information systems at the level of community, districts and state projects, and by extension, the larger national HMIS (Free et al., 2013; Mechael et al., 2010; Whittaker, 2012). This study contributed to filling this need by investigating HMIS within the institutionalized setting of the ministry of health.

A major implication of this thesis’ findings for HMIS practice is that practitioners should no longer see the mobile phone (and other components of the emerging HMIS) as a standalone device, but as one within a broader institutional and socio-technical context. For example, the paper forms and registers that are summarized and reported using the mobile phone application need to be made available (through the complex interorganizational supply chain for paper forms) and filled in by many workers

across the health facility (sometimes, many departments are involved). Such effort requires mutual understanding and coordination at the level of the organization (the health facility) as well as at the level of the ministry of health. There are also the mobile companies, the servers at the state level (sometimes national level), and the established practices and logics in the different organizations that are all required to align and support the adoption and institutionalization of the HMIS. In the empirical material, there were also new organizational routines and requirements such as charging facilities (electricity supply/storage), on-time technical support, mobile network coverage, scheduling mobile submissions to the server, etc. that was needed to work to make the mHMIS implementation successful. Thus, mobile HMIS implementations need to be sensitively designed, and introduced with an understanding of the institutional context in order to achieve successful implementations of mobile-supported HMIS in low resource settings.

Another implication of this research is the institutional mechanisms by which mobile-supported HMIS helps support the extension of the computer-based HMIS logic. From the empirical setting of the NEHSI project, we showed that these mechanisms include its facilitation of savings in financial and human organizational resources (economic logic), how it significantly increases organizational information quality (efficiency logic), how it facilitates organizational restructuring (in a way the mHMIS serves as an occasion to restructure) and lastly, by helping to create new possibilities for institutionalized HMIS data collection (that is, doing data collection in a way that was previously possible for the organization). With such findings, implementers are able to approach mHMIS practice more boldly as an evidence-based approach to meeting organizational goals of HMIS, and also with a deep appreciation of the institutional aspects of the settings they work in.

Thus, as a significant practical contribution, this research raises the attention of practitioners to the often-invisible institutional aspects in an implementation, and hence emphasizes the criticality of understanding the underlying logics that guide their clients' actions and decisions.

Generally, emphasis on the institutional perspective is beginning to gain some traction. I say this because this perspective is being appreciated and is now echoed by some practitioners who believe that it was a mistake in the past to focus on the mainstream health sector and the HMIS at the expense of the institutional context, and that future implementation of HMIS should address the considerably political system, the much more heterogeneous system and expanded roles for non-health actors (Seo and Creed, 2002). According to this emerging view of HMIS practice, a successful system would be one based on practical, socio-politically acceptable and institutionally embedded technologies that make information on health-related activities accessible at the different levels and/or aspects of care with the necessary level of relevance at every stage of the system's development.

b. Managing the Complexity of the Implementation process

First, as previously explained, it is critical to recognize the course of HMIS implementation as a complex institutional process, one that requires navigation through logics since HMIS implementation is driven by logics, and this contributes to its complexity. The current literature on HMIS literature focuses on issues like sustainability, scalability, local ownership, decentralization, etc. From the perspective of this thesis, these are simply institutional logics emanating from the main participants in the HMIS

implementation process - the nongovernment organizations, the state and district governments, the 'technical' implementers. These participants reinterpret how these principles should be implemented; leading to some competition for dominance in major thought process in the project – that is, how the project should proceed, and what interpretation gets inscribed.

By contributing to the understanding of institutional aspects, this thesis sensitizes practitioners to the complexity of the implementation process. This is sometimes taken for granted but can have serious implications for the way mHealth data collection could be successfully implemented. An improved understanding of the implementation process can cautions practitioners against adopting simplistic approaches that are based on naïve technical assumptions. For example, in introducing technology to an organization such as the HMIS in the ministry of Health bureaucracy, implementers may need to address both the hierarchical (bureaucratic) logics that guide action and decision at a typical ministry of health in a developing country. As explained in one of the papers (paper 3), the network logic of mHMIS can sometimes tends to lead to a bypass of hierarchical and bureaucratic levels. However, those bypassed feel a loss of power and authority, and a loss of inclusion or participation in the implementation process. They need to be involved. This was solved in both projects by embedding some level of hierarchical control in the networked data submission. The implications for mobile-supported HMIS is that the implementation process needs to be aware of power structures and the conflicts that can result from introducing a technology that can disrupt pre-existing hierarchical organizational structures.

This has implications for understanding the context. For example, it is not enough to conceptualize HMIS implementation as involving matching technology to the often-poor infrastructure but also being aware that because the context also involves logics; it may involve matching with the dominant logics, and perhaps resolving conflicts that may arise. It also appears that there are implications for ICT4D especially when we think of how such conceptual insights can help reduce failures and help make ICT4D implementations more successful. It thus facilitates large-scale HMIS development and implementation in developing countries. This is particularly relevant, in such settings where resources are already limited, and the pressure to perform is high. However, resolving conflicts is not a straightforward process and may lead to a complex and long development process, which demands much patience. An appreciation of this patience requirement can come from a deep understanding of logics, and this can help foster less failure with ICT4D implementations.

Many HMIS implementations, by virtue of involving multiple actors, will involve an interaction of many institutional logics with some conflicting in the implementation process. From a practical perspective, implementers need to take these logics more seriously. The empirical insights from this thesis sensitize us to the role that conflicting institutional logics play by increasing the risk of project failure, when not resolved. This is particularly important as success or failure often is constructed through the logic by which actors perceive the implementation process. Therefore, it appears that for implementations to be successful, implementers may need to negotiate and navigate the different logics of the participating actors. In cases where these negotiations were not possible e.g. in the cases described by some authors (Avgerou, 2004; Kaduruwane, 2012; Silva and Hirschheim, 2007), the implementation was unsuccessful. In developing countries, especially with limited resources, if we can improve in the negotiation of the conflicting logics that arise in implementations, we may significantly improve the

implementation of HMIS, and improve health systems and foster socioeconomic development down the line.

While HMIS implementation generally is seen as a difficult and complex process, I posit that understanding the dominant and conflicting logics at play can provide implementers with insight into aspects to examine when performing needs and situational analyses as well as when developing implementation and change management strategies. This thesis has already highlighted some of the logics that should be considered – e.g., the need for decentralization, hierarchy and centralization, long-term sustainability, ownership, universal coverage (and scale up) and short-term project focus - and the conflicts that may arise between them. Preempting and planning for these logics may enhance the prospects of HMIS implementation success, especially in developing country MoH contexts. Finally, practitioners should not underestimate the effort required to do this. And the process needs to be seen as emergent, as something built by the participants in interaction rather than being the product of a formalized approach to IS implementation.

Though the focus has been mostly on the socio-organizational aspects, the technological artifact plays a role on information system artifact design and development within the context of conflicting logics. This may need to be done in ways that support the transition between logics (transitional resolution) or in ways that support the coexistence of multiple logics (dialectical resolution). I believe that in our PRRINN case, the ability to navigate the different logics was partly because of the flexibility of the artifact and how it could differentially support multiple, and even conflicting logics.

Practical implications for organizational change in the MoH

The organizational structure found in MoH illustrates a strong bureaucratic nature. And as is typical in bureaucratic settings, it can be difficult to make significant organizational change in the ministry of health. This is a major challenge in organizational studies. With simple small firms, you can more easily change the structure of firms to meet up with changing work but in such ministry of health, the structure is locked into the historical contingency of logics. It is difficult to change and it can take many years for organizational learning to occur.

Looking at the history of organizational analysis, many foundational studies were done in the developed world and focused on firms whose leadership recognized the need to adapt and restructure in adaptation to changing environment. As such, the theories were built on firms where you can more easily restructure. The reverse is the case in most developing countries MoH because they appear to be locked into strong hierarchical and bureaucratic patterns. Such departments, like where this research was mostly based, faces challenges with change. In Nigeria, the last and most of the restructuring were done in the military era in a strict command and controlled atmosphere. Performance is touted as the end goal but in many of such settings, the external environment plays a huge role such that performance is not a major goal. Changing such situation may involve understanding the role of resolution mechanisms and institutional entrepreneurs. Organizational strategies need to be made in line with supporting these entrepreneurs and their role in helping the organizational change process.

Contributing to evaluation

The evidence and discussions seem to suggest that the institutional logics construct can help facilitate more detailed evaluation of HMIS implementations in terms of evaluating acceptability and alignment

of participants in a project. By framing institutional logics as constitutive of institutional context and complexity, project planners and evaluators may be able to unpack and preempt any possible conflicts or tensions that may arise. The institutional logics approach can thus contribute to formulating indicators for evaluating implementation. For example, analyzing what logics are met and which are not met in an implementation and thus can help mitigate risk and increase chances of success.

6.4 Further research

This thesis can also contribute by shaping and influencing the agenda of future research. In this section, I point to such future work (theoretical and practical) that can arise from this research.

From a theoretical perspective

By developing and enriching an institutional logics perspective to HMIS/mHMIS, the understanding of HMIS implementation has improved both in relation to theorizing the context and complexity as well as in relation to understanding the role of tensions and conflicts. Expanding this further can be the basis for future exploration. For example, we can explore more deeply 1) how changes in logics within implementations are maintained beyond their enactment; 2) these logics in a wider range of empirical settings; 3) if the logics found are truly generalizable; 4) how might their enactment in settings like in developed country settings be; 5) If there are other project conflict resolution strategies used in other settings.

The research presented in this thesis also identified new concepts with new interesting possibilities for future research. These concepts could be explored further and applied to a broader range of settings.

Limitations

There are also limitations to the approach this thesis has taken, that future research may help address. In this subsection, I identify a few of these.

Firstly, exploring institutional contexts and logics is a crucial and important but ambitious goal because institutions take time to form and to change; and exploring changes in institutional logics consequently translates to challenging timelines (sometimes running into decades). However, I have attempted to approach this pragmatically and explore the logics within the time-bound projects I chose, and especially within the limits of a PhD timeline. However, there is a place for more extensive studies, especially ones that can explore the possible growth and collapse of logics within the HMIS. It will also be interesting to follow, through a long time, how some of the logics and the context of the HMIS that we reported here could evolve. Perhaps it may be found that they were micro-patterns, and that there are even larger institutional patterns that unfold within a longer longitudinal exploration.

Secondly, the study was limited to two relatively homogenous areas (and few states) in Nigeria. Perhaps there is a relation that may be found between culture/ethnicities and logics and context, if the study were comprehensive and involving more culturally diverse areas – for example, more states in more areas of Nigeria.

In addition, mHMIS is a dynamic and burgeoning field, and some of the findings may be indicative of the fledgling nature of the domain. Perhaps, as the domain matures, the findings may be radically different. It will be interesting to compare results from upcoming studies in the next decade with the findings from mHMIS research in the last decade. It will also be interesting to follow the evolution of mHMIS

implementation, as it will be useful for understanding the historical contingency and how the installed base evolution will influence even future developments. Additionally, from the perspective of conflicting institutional logics, knowing the best way to resolve each conflict would be also interesting.

6.5 Concluding Remarks

I conclude this chapter with some remarks on the generalizability of the research and some thoughts. In making the contributions discussed here, I have made generalizations and interpretations from my cases. I have supported these generalizations comparing with other cases and generated explanations that are sometimes contextual, and at other times, beyond the context (especially where other cases make it a valid conclusion). For example, if other authors have reported the same or similar phenomenon, I have considered such a valid conclusion beyond my context. An example is the conflict in logics (paper 4), where I go at lengths to show that these have been corroborated in other settings and should be considered important general phenomena.

However, in this thesis, I do not claim that what I have explained are the only institutional logics that can be seen. Instead, I am proposing and theorizing a particular way of viewing and conceptualizing (that is interpreting) them in a way that may provide us with a greater explanatory power than from other approaches. Therefore, the focus has been on explanatory power rather than producing universal laws as in positivist studies. The goal has been to generate what can help us achieve better understanding of our settings as well as similar settings using insights from the research.

As this thesis has been much focused on institutions and social aspects; so, there is the risk of tilting excessively towards the social view of the world. I will like to reiterate that technology itself can contribute to the complexity of implementations. HMIS implementations still face technological hurdles ranging from writing stable scalable software, flexible and extensible systems, and software that is optimized for the poor internet connectivity and electricity supply in low resource settings, etc. In adding this caveat, I reaffirm that a balanced view is needed that does not tilt towards core social constructivism nor technology determinism.

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APPENDICES - PAPERS

Paper details	
1	Asangansi, I. (2012). Understanding HMIS Implementation in a Developing Country Ministry of Health Context - an Institutional Logics Perspective. <i>Online Journal of Public Health Informatics</i> , 4(3).
2	Asangansi I (forthcoming). Is mHealth Disrupting the Status Quo? Evidence from Implementations Highlighting Network vs. Hierarchical Institutional Logics. Submitted December 2013 to <i>Electronic Journal of Information Systems in Developing Countries (EJISDC)</i>
3	Asangansi, I. & Braa, K. (2010). The emergence of mobile-supported national health information systems in developing countries. <i>Studies in Health Technology and Informatics Journal</i> , 160(1), 540. (Initially presented at MEDINFO 2010 Conference, South Africa)
4	Asangansi I, MacLeod B, Meremikwu M, Iwara A, Roberge D, Hartsock B, Mbotto I (2013) Improving The Routine HMIS In Nigeria Through Mobile Technology For Community Data Collection. <i>Journal of Health Informatics in Developing Countries</i> vol 7 issue 1 p76-87
5	Asangansi, I. & Shaguy, J. (2009). Complex dynamics in the socio-technical infrastructure: The case of the Nigerian health management information system. <i>Proceedings of the IFIP9.4 10th International Conference on Social Implications of Computers in Developing Countries, Dubai</i> .

Understanding HMIS Implementation in a Developing Country Ministry of Health Context - an Institutional Logics Perspective

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Abstract

Globally, health management information systems (HMIS) have been hailed as important tools for health reform (1). However, their implementation has become a major challenge for researchers and practitioners because of the significant proportion of failure of implementation efforts (2; 3). Researchers have attributed this significant failure of HMIS implementation, in part, to the complexity of meeting with and satisfying multiple (poorly understood) logics in the implementation process.

This paper focuses on exploring the multiple logics, including how they may conflict and affect the HMIS implementation process. Particularly, I draw on an institutional logics perspective to analyze empirical findings from an action research project, which involved HMIS implementation in a state government Ministry of Health in (Northern) Nigeria. The analysis highlights the important HMIS institutional logics, where they conflict and how they are resolved.

I argue for an expanded understanding of HMIS implementation that recognizes various institutional logics that participants bring to the implementation process, and how these are inscribed in the decision making process in ways that may be conflicting, and increasing the risk of failure. Furthermore, I propose that the resolution of conflicting logics can be conceptualized as involving deinstitutionalization, changeover resolution or dialectical resolution mechanisms. I conclude by suggesting that HMIS implementation can be improved by implementation strategies that are made based on an understanding of these conflicting logics.

Keywords: Legal and Social issues in Public Health Informatics; developing countries; health management information systems; institutional logics; institutional aspects of information systems; action research; Nigeria; Ministry of Health; change management

Introduction

Health management information systems (HMIS) refer to information systems for health management at district, state, regional and/or national level(s). By implication, they are often government-led and assumedly the foundation for decision-making within health ministries. Globally, they have been hailed as important tools for health reform (1). However, they are yet to

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live up to expectations because of the significant proportion of failure of implementation efforts (2; 3). Researchers have attributed this significant failure of HMIS implementation, in part, to the complexity of meeting with and satisfying multiple interests and logics in the implementation process (2; 4; 5). Particularly, an emerging body of literature characterizes this situation as that of competing or conflicting institutional logics: a situation where decisions and actions in the implementation process are contested by the different (and sometimes divergent) rationalities or belief systems of the different actors involved (5–7). Accordingly, researchers have indicated the importance of understanding these institutional logics, including how they shape and are embedded in the implementation process, and how they may increase the risk of failure. For example, Chilundo and Aanestad (8) opine that discerning the multiple rationalities that shape implementations is a prerequisite for understanding the implementation process, and a major step towards developing change management strategies to improve it and reduce failures.

This is particularly relevant in the context of developing countries where investments in HMIS implementation draw on already stretched resources. In Nigeria, the empirical context for this paper, the implementation of HMIS is a major concern for the government and its partners, and has been a central component of its public health reform (9). Yet, since its first HMIS implementations in the 1990s, the Nigerian government has continued to struggle with the deployment of information systems to support its public health strategies with limited success (10). However, the recent renewed vigor for HMIS deployments fueled by substantial commitments from international donors and the government's avowed pursuit of the Millennium Development Goals (MDGs) is creating a situation where an in-depth understanding of HMIS implementation and the institutional logics that shape them are desperately useful if not crucial.

This creates an imperative for hands-on implementation research that can derive lessons that are practically pertinent, contextually relevant, yet theoretically sound such that they can be reused in similar settings (11; 12). Furthermore, the paucity of research in this regard as well as the potential to contribute to the broader sphere of research into institutional logics in information systems implementation add to the strong research motivation for this work.

Empirically, this paper discusses an action research undertaken in Katsina State, Northern Nigeria, with the participation of multiple actors in an HMIS implementation. The implementation provided an opportunity to unravel how conflicting institutional logics may shape an HMIS implementation process. This paper aims to capture and conceptualize these logics and conflicts as well as how they were resolved, and then to suggest implications for practice and research.

The composition of the rest of the paper is as follows: the next section explains the conceptual notion of institutional logics, on which the analytical objectives of the paper lie. Thereafter, the methodology utilized is explained, followed by a description of the context and the findings, interspersed with analytical insights. The paper then presents an analytical summary, after which a discussion on the logics, the conflicts, and the approaches to resolving the conflicts are presented.

Conceptual Framework - Institutional Logics

The theoretical aspects of this paper are founded on an organizational analytic approach based on the concept of institutional logics. Institutional logics refer to belief systems that are carried by a collection of individuals, guiding their actions and giving “meaning to their activities” (13; 20). They “provide the formal and informal rules of action, interaction, and interpretation that guide and constrain decision makers in accomplishing the organization’s tasks” (14). These logics inscribe the “organizing principles” that shape participants’ thinking, influencing both the means and ends of their behavior (15). Thus, institutional actors reproduce logics dominant within their institutional setting (13). Examples of pervasive institutional logics include religious inclinations, marriage preferences, cultures, political ideologies, professional tendencies and ethnically influenced behavior (15; 16). More specifically, and related to our concern, the concept has been applied to understanding information systems implementation in organizations and in a wide variety of domains (6; 17) including the health domain (18–23). These authors describe how institutional logics are embedded within health information systems implementations. Particularly, focus has been on the situation where these logics conflict or compete. For example, Gutierrez and Friedman (23) explain that HMIS project goals and expectations often expose contradictions in the different institutional logics. They argue that HMIS implementation design and planning efforts represent a natural source of contradiction and often involve incompatible perspectives and logics. Similarly, Currie and Guah (20), on analyzing the HMIS in the United Kingdom, describe healthcare as:

“infused with institutional logics emanating from various sectors across the field. Healthcare is politically contentious where societal level logics created by government are embodied in policies and procedures that cascade down from the environment to organizations. Various stakeholders including clinicians, managers, administrators and patients interpret and re-interpret these logics according to the degree to which they affect changes to the perceived or real material resource environment of the institutional actors”.

Currie and Guah (ibid) further argue that “one of the significant challenges facing HMIS implementation is to reconcile competing institutional logics.”

Similarly, Avgerou (21) articulates, in her analysis of an HMIS implementation in Jordan, that the HMIS project had to satisfy two lines of authority with divergent logics - the local bureaucratic structures of the health services, and the USAID (United States Agency for International Development) mission - whose fundamental values and principles about development and organizing were in conflict. She describes:

“These clashed on several issues. Initially, the USAID mission, consistent with its general policy of promoting administrative decentralization, favored a system to address the planning requirements of the 12 governorates (regions) of the country, excluding the central decision makers from the system’s reporting flows. This created friction with the Ministry of Health (MoH), in effect attempting to circumvent technically the current power structures (at the ministry). Second, from the initial conception of the project, the

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USAID mission wished to focus exclusively on improving the quality of reproductive health services, which is another area of concern and policy for this development agency, (to which the ministry was strongly in disagreement). The aid recipient negotiators of the Ministry of Health shifted the emphasis of the project to primary health care (PHC) instead. Nevertheless, after analysis specifications were drawn and the first prototypes built, a new USAID mission director raised the family planning issue again and asked for the specifications to be changed” (21).

Avgerou, thus, highlighted two conflicts: one between the logics of decentralization and centralized control; and another involving the scope of intervention between a ‘vertical’ focus on reproductive health (by USAID) and a horizontal broad focus on primary health care (by the ministry).

Recognizing the central role that conflicting logics play in the implementation process, researchers have emphasized the need to understand how to resolve such conflicts. The current understanding is that the resolution of such conflicts usually takes place through a change management process involving *deinstitutionalization* of one logic and the institutionalization of another (19; 24–27). *Deinstitutionalization* refers to the process by which institutional logics erode and disappear (25). Sahay et al (19) apply this to describing their work in deinstitutionalizing the logic of paper-based data collection and the institutionalization of a computer-based (electronic processing) logic. However, I argue that conflict resolution in change management processes can also occur without deinstitutionalization or the extermination of one logic. I demonstrate in this paper that the resolution of conflicting logics can occur in an implementation through processes other than deinstitutionalization. I identify two such processes, which I have termed *changeover resolution* and *dialectical resolution*. I use changeover resolution to refer to the situation where participants reach a compromise, and then move the project from one dominant logic to another. In other words, changing over dominant logics, yet acknowledging the weakened logic, which becomes recessive but can later be operationalized. On the other hand, I use *dialectical resolution* to refer to the situation where conflicting logics are resolved through an approach that synthesizes the competing logics into one solution, rather than exterminating one for the other. Here, I adapt the concept of Hegelian dialectics as applied to organizational change i.e. that organizational change occurs through tensions and contradictions, resolved through a synthesis of competing logics (28–33).

In sum, conflicting logics can be resolved through deinstitutionalization, changeover resolution or dialectical resolution. The choice of one depends on the logics involved. Thus, it is important that conflicting logics are identified and understood within projects. However, within HMIS research, there remains a large gap in understanding and identifying institutional logics and the conflicts that may occur between them. This study contributes to filling this gap.

Methodology – The Action Research

The study in this paper focuses on a case of HMIS implementation involving an attempt at introducing and institutionalizing an HMIS software within a Ministry of Health (MoH) with the involvement of many actors. These actors included an international donor funded nongovernmental organization (anonymously referred to as NGO in this paper), a (technical)

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implementation team, the National and State ministries of health, district health information officers, and health facility workers. The empirical context of this study, as will be described later, is thus a rich one, providing a good setting for studying institutional logics, including how they may shape HMIS implementation.

However, studying institutional logics demands an approach that involves being grounded in the context and interacting directly with the logics through active participation with the associated actors. The action research (AR) methodology provides this avenue as it ensures active participation in an organizational change situation while undertaking rigorous theoretically informed research (34; 35). The author was involved as an implementer-researcher within the Health Information Systems Programme (HISP) team, a long-term action research project implementing HMIS in developing countries. AR was applied to this research using the phases described by Susman and Evered (34) - problem diagnosis, action planning, action taking (intervention), evaluation and reflection (see Figure 1 below). In this case though, the phases were not determined beforehand; rather, they evolved and emerged phase after phase, as it was uncertain what the next issues were going to be, or if there would be continued funding for the work. Each phase was decided based on problems and opportunities in the preceding phase, but the implementation and decision-making hinged on the availability of funding, which was intermittent and weak. Thus, planning was piecemeal, rather than following a carefully thought-out 'grand scheme'. Overall, there were four overlapping implementation¹ phases. These phases (also in Table 1 below) include: the establishment of a sentinel system and introducing a computer-based HMIS; strengthening the State HMIS and piloting the mHealth technology; stabilizing/institutionalizing the mHealth technology by hosting internally at the MoH; and finally, migration to Internet-based DHIS2 with remote access through mobile modems.

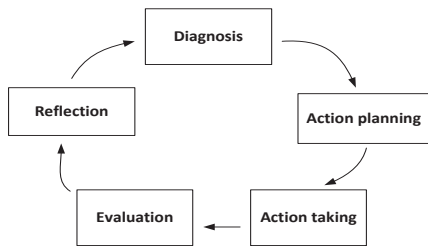


Figure 1. Components of an action research phase (34)

Table 1. Four action research phases carried out in this study.

Phase 1 - Establishment of sentinels; introducing computer-based HMIS
Phase 2 - Strengthening the State HMIS and introducing mobile technology
Phase 3 - Stabilizing/institutionalizing the mobile technology by hosting internally at the MoH
Phase 4 - Migration to the Internet with remote access through mobile modems

Data collection

¹ Implementation in this paper refers to the processes of action planning, action taking (intervention) and evaluation as described in action research (34, 35)

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Data collection was ethnographically informed (36; 37) and was done through participant observation (38; 39). The author was involved in all stages of the study, with more involvement in the first three phases. Seven field trips were made between 2008 and 2012, each trip lasting between one and three weeks. Besides the field trips, the implementation work involved numerous phone calls, Skype calls, emails and use of remote login software. Before the study, the author had worked within the MoH in a neighboring state with similar socio-organizational characteristics (language, culture and MoH organizational setup), and had some understanding of the context. Data collection (into field notes) was conducted through activities such as implementation planning meetings with the NGO, discussions with state MoH and district officials; collaborative software customization and configuration activities; field visits to implementation sites; and training and evaluation trips to districts and health facilities.

Data analysis and interpretation

The focus of analysis was on the implementation project, taking it as an organizational field where the actors and their institutional logics play. The collected field notes were analyzed to capture the dominant logics of the different actors in the different phases. Thus data analysis — moving from raw data to interpretation - was based on reiteratively reading and identifying recurring themes from the field data. The data was then transferred to and coded in Nvivo software (40), where case dynamics matrix displays (41) were generated from the institutional logics identified during the reading and rereading process. The notions of institutional logics and its relations were used as a sensitizing device (42), for interpreting meanings and for understanding rationalities behind the dynamics of the implementation process. Nvivo's support for the framework analysis method (43; 44) was used to generate these displays (see figure 2) and help visualize and identify 'what was really happening' in the collected data.

In the next section, I present the action research narrative phase by phase, combined with analytical insights into the dominant logics. Before this, the organizational context is presented.

Case and Findings

Organizational Context

The Nigerian government has long considered the application of ICT as vital to improving the monitoring and evaluation of its public health system via strengthening the system of data collection from health facilities (9). The availability of timely and accurate data is fundamental to improving decision-making within the public health administration, and would help move the country away from its poor health indices. Nigeria, with a population at 162 million (45), is Africa's most populous country and among ten countries with the world's worst public health indices: maternal mortality is as high as 1200 per 100,000 live births in some states, i.e. approximately three hundred times more than the average in, for example, Italy (with 3.9 per 100,000 live births). Similarly, infant mortality is among the world's highest; for example, the last published figures (2003) had infant mortality as high as 100 deaths per 1000 births, compared to 64 in neighboring Ghana and approximately 4 in developed countries such as Norway and Italy in the same year (46).

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Since Nigeria's return to democratic rule in 1999, after three decades of military government and systemic neglect of the health care system, there have been concerted efforts at meeting the Millennium Development Goals (including reducing maternal and child mortality). Consequently, public health care reform has been prioritized. These recent reform efforts have been met with increased international vigor and foreign aid to boost the fight against maternal and child mortality, and have involved a focus on strengthening the public health management information system. This paper is centered on a case where foreign aid channeled through an international donor-funded NGO was applied to strengthen the health data collection system in Katsina State, Northern Nigeria.

Katsina State is one of Nigeria's 36 states, and lies at its Northern border with Niger republic. With a population of approximately 6 million, it is Nigeria's fourth most populous state – and sixty percent of the population is rural (47). It has a low GDP per capita; over 70% of the population subsists on under 1USD per day and unemployment is over 25% (48). Katsina State is divided geopolitically into 34 local government areas, hereafter referred to as districts. The state has one of the worst indices for maternal and child health in Nigeria, and is considered by the federal government as an educationally less developed and disadvantaged state (49). Successive governments in Katsina State have continued to invest in primary health care (PHC): recent efforts have been aimed at building and rehabilitating PHC facilities, provision of equipment, and the implementation of mobile ambulance services particularly to the state's difficult-to-reach and rural geographical areas (50). However, management systems such as HMIS have not received much focus, as priority is given to 'tangible' goods like drugs, health personnel, and buildings. This is the case in much of Nigeria, where investing in public health management resources is in tension with providing physical deliverables in a sociopolitical system where the masses are desperate for tangible results from the polity.

The current project was initiated by the NGO whose focus was on working with the Katsina State government and districts to improve the availability of maternal and child health services, as well as strengthen the structures and systems that underlie these services. The goal was to establish an information system that could track, monitor, and evaluate progress as well as help strengthen the capacity of state and local government health departments to plan, make decisions and act, based on health data. In addition, the NGO was interested in quickly establishing a monitoring and evaluation (M&E) system to collect data that could be used to demonstrate progress to stakeholders and funders. Thus, there was a project-based quick-fix rationality in the foreground, although there was an implicit understanding of the rationale of strengthening the routine system of data collection in the state. Wary of establishing a new parallel information system, and dedicated to adapting to the development ethos of strengthening the state information infrastructure, the project considered the existing (weak) state HMIS as its point of departure.

The HMIS

The HMIS is responsible for data management and statistics within the health ministry at national, state, and district levels. It was established as a "management tool for informed decision-making at all levels" (10), functioning to assess the state of health of the population, identifying major health problems, and monitoring progress towards stated goals. Data flow was

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designed to be hierarchical, and in a command-and-control structure that reached from health facilities to districts, to state, and then to the federal level.

However, although administrative positions were set up and staff employed, the HMIS remained dysfunctional. HMIS forms were usually unavailable at health facilities, health workers were not trained on how to fill the forms, and filled forms were not submitted. According to the MoH:

“As a result of neglect and underfunding over the years, the National Health Management Information System suffered a lot of setbacks and could not meet the objectives for which it was set up. It has been defective and hence it is not possible to calculate even the simplest indicators” (10).

The HISP implementation team was invited by an NGO working in Katsina state to help with HMIS reform and implementation based on the existing national HMIS policy and established guidelines.

Phase 1: Establishing sentinels and strengthening the State HMIS

At the beginning of the project, an initial assessment was done which revealed a weak State HMIS system. The HMIS unit was poorly staffed and existing staff were not computer literate. In addition, there were no dedicated computers for HMIS activities and the paper forms/registers recommended by the federal HMIS were not budgeted for. Altogether, there was no culture of information collection, processing, and use.

Much thought was put into how to approach the task of improving the HMIS from the state level through 34 districts to over a thousand health facilities. With limited resources, a prioritization approach was adopted by the NGO to allow focus on a few selected 'representative' facilities while beginning the process of strengthening the routine State HMIS team. An improvised sentinel site monitoring system (SSMS) that could swiftly provide some of the initial information required for the monitoring and evaluation of activities was setup.²

The initial setup phase of the sentinel monitoring system lasted five weeks in April/May 2008 and involved planning meetings with the senior management of the MoH, selection of sites, training sessions, and installation of the HMIS software system at the State MoH. Health facilities with the highest level of utilization by the populace (using estimates of maternal and childcare visits) from each of the state's five zones were chosen to satisfy both geographical and political representation. The officers-in-charge of the sentinel sites and their respective district health officers were trained on the indicators, sentinel system forms, and the data flow for the sentinel site system. After a series of training, monthly data collection by participating health facilities commenced with the forms, which had six indicators focused on immunization. These forms were submitted to the state HMIS office where they were aggregated and analyzed. Analysis was done using the District Health Information Software version 1.4 (DHIS 1.4). The DHIS 1.4 is a Microsoft Access-based software system for the collection, collation, analysis, and

² A sentinel site is a health facility that can provide information considered to be representative of the population's health indices - serving as a proxy for assessing the health system.

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presentation of aggregate statistical data designed for the HMIS. It is a generic tool with a flexible configuration system that allows for easy definition of data collection forms. The choice of the DHIS was based on its adoption by the Federal MoH as the de facto standard for public health information management in Nigeria (51). The introduction and configuration of the system was used to train the State HMIS Team on basic HMIS functions as well as DHIS installation and data entry.

Subsequently, follow-up field visits were made to assess the system while providing on-the-job training for health information officers and technical support. Monitoring visits were made to follow-up on the progress that had been made in strengthening the HMIS and establishing the SSMS. During the visits, on-the-job training was facilitated and technical support was given. However, during follow-up visits, based on feedback from the state government that the project should scale up, 31 new sites were added to the initial 14.

Conflicting Logics - Sentinel Project focus vs. Statewide focus

The focus on sentinels introduced minor tensions. It appeared that while HMIS was systemically weak, the priorities of the NGO required a quick solution. The NGO's logic of implementing a quick-result-seeking system focused on time-bound results was in slight conflict with the state ministry's focus on the entire routine HMIS. The state ministry's logic was to strengthen the HMIS statewide and across all aspects of PHC rather than what they considered a quick fix sentinel system focused on one program (immunization).

As one of the state ministry's health managers argued, "the implementation needs to involve all the districts, health facilities and all aspects of the HMIS, and not just collecting immunization data in a few selected sites." On the other hand, the NGO had concerns about spreading too thin across the state. Yet, it was generally acknowledged that the sentinel system needed to be gradually adapted into a broader statewide routine data system, so that it could be adapted into the state's broader agenda of universal and equitable coverage.

A district officer involved at this stage also noted:

"While it is appreciated that the sentinel system is important to monitor NGO interventions, the associated data collection, flow, and analysis should be part of an overall strengthening of the monitoring capacity of the district and state, rather than as a vertical NGO immunization-focused activity".

With further discussions, the focus began to shift towards the state and district. A more extensive evaluation of the HMIS at all levels and in all districts was thought necessary. Thus, the conflict in this phase was an enabler for the next phase.

Phase 2: Expanding Focus from sentinels to strengthening the routine State HMIS, and introducing mobile technology

Following recommendations from the previous phase, an extensive situational analysis was undertaken in the first quarter of 2009 involving the state, district, and health facility levels. It revealed the very low base from which the HMIS had to be developed. The evaluation showed

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that there was difficulty with distribution of data collection materials to district facilities across the state. Moreover, district HMIS staff had a very poor understanding of the required data collection, collation, and analysis techniques. Furthermore, it was difficult to maintain computer systems within the local governments, with their characteristic poor power supply and sometimes-nonexistent budget for HMIS activities. In addition, transportation between the state and the districts was difficult because of bad roads and a challenging terrain, especially to and from the rural areas. Paper forms were largely unavailable as the state had failed to provide them; reports from the facilities were submitted late to the state/district and data quality was untimely and often incomplete; and communication between district officers and the state HMIS office was poor. Sentinel sites did some reporting but using immunization-focused forms.

With improved mobile network coverage in Katsina (as in the rest of Nigeria), an opportunity to use mobile technology to circumvent some of the mentioned data collection challenges was identified. In addition, the NGO decided to expand the work on the SSMS into the statewide routine HMIS. The routine HMIS became the focus of the intervention.

A large-scale program of training of trainers for the HMIS was designed and implemented. HMIS officers from key data-producing organizations in the state such as the State PHC Board, the State's main hospital, and the districts were included. The focus was on attaining great effect first at the level and then at lower levels. At the same time, a HMIS Mobile pilot was designed with the goal of exploring the possibilities of using mobile phones for the collection of data from the districts and health facilities. The HISP team developed a simple form-based mobile application for collection and transmission of data into the state level DHIS 1.4 instance. In designing the application, mobile network coverage fluctuations typical of such settings were considered. Data were stored on the phone using a basic Java-based Record Management Store (RMS) functionality, allowing data to be forwarded when mobile network reception returned. It allowed for the retrieval of previously filled reports, adapting well into the context of mobile network signal fluctuations. The application utilized only the basic Java functionalities, such that it could be installed on inexpensive low-end phones. All district officers in the 34 districts were provided with the mobile tool, so that they could submit data for facilities in their areas. Data transmission was via SMS. In addition to the 34 districts, 13 facilities were chosen as pilot sites. The participants were trained on the mobile application and the HMIS forms, and the system was piloted the following month (October 2009). As forms were now budgeted for, advocacy to the state to print forms yielded results. The NGO also printed forms for distribution. With the transition in focus from sentinel to the routine HMIS, the national HMIS forms were introduced for the first time in Katsina. This meant that the mobile training also included training on the content of the form. The contents included all major aspects of PHC, as the state wanted to include items on antenatal care, pregnancy outcome, mortality, family planning, immunization, child nutrition, community outreach - in total, 48 data elements.

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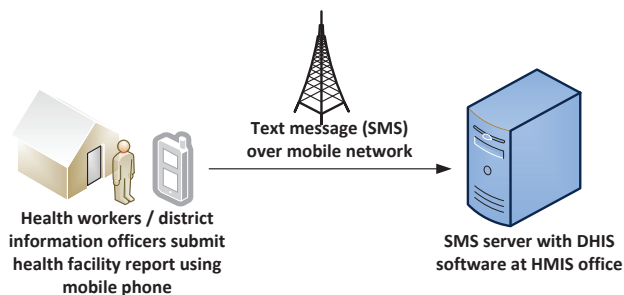


Figure 2 shows the architecture of the mobile data collection system.

On evaluation, positive results were found showing that the implemented mobile solution had a good technical adaptation to the data collection challenges. A simple questionnaire administered to evaluate participant acceptance of the mobile application showed that the application was perceived as useful and appropriate. The district officers and the heads of the pilot facilities were enthusiastic and excited about the system. For the first time, data report submissions were timely. In addition, it obviated the need for long travels (sometimes up to six hours) just to submit a paper form. Overall, a major finding was that the application was well received. As one of the state resource persons said, "let us not call this a pilot because it is bringing very useful results and is now part of the system." One-hundred percent of the district workers and pilot facilities reported that they preferred this way of reporting as it saved time -they did not need to travel to report - and it was more efficient.

Institutional logics at play - Ownership and Sustainability

With this acceptance and adoption by participating facilities, districts and the state levels there was increased interest in the sustainability and ownership of the system. Of concern was that in these first months the mobile (SMS) server for receiving data was still hosted with HISP outside the state. Considering the logic of local ownership and the rationality of strengthening the state's routine HMIS infrastructure, it was considered appropriate to move the SMS server to the state HMIS office so that all data were locally hosted. As one of the state HMIS officers said, "We need to be able to run this system here and without your assistance, so that when the project ends we can continue to run it."

It is important to understand the context; this was a region involved in a disagreement few years before over the safety of polio vaccines, pitting community and Islamic leaders against the WHO, UN, UNICEF, and Federal authorities over fears that polio vaccines were a weapon by Western and international powers (52). The dominant logic from the state was that the system needed to be owned and controlled by the state, and that ownership would lead to sustainability (and perhaps more trust in the system). Ownership here was defined as physically hosting the server (at the MoH). However, the logic from the side of the implementers was on concerns with server stability, maintenance and uptime in the ministry. Yet, the NGO and state agreed on the need for the state to host the SMS server locally. The next phase involved navigating the

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institutional context of the HMIS and exploring how the system could be institutionalized at the state HMIS.

Phase 3: Attempting Ownership and Institutionalization - Mobile server moved to the MoH

The next line of action was to move the server to the state HMIS office as part of an institutionalization effort. The SMS server was transferred to the state HMIS office and the state HMIS officer trained on its use and management. The move of the server to the state MoH was fraught with a number of issues, including: poor and erratic power supply for the server, short storage of SMS by the mobile network companies, work culture issues, poor server care/maintenance and unauthorized tampering/fiddling. These are explained further.

Power supply is a perennial problem in Katsina State. For the project and the ministry hosting the server, this meant running power generators. However, this introduction brought with it a significant amount of new work for the ministry. They had never been expected to have electricity daily. The ministry was unable to maintain power supply for the SMS server as fuel for the generators was unavailable most of the time because of budgeting/funding and logistical issues. To compound the problem, as was discovered subsequently, SMS's were not stored by the mobile network for longer than 24-72 hours (depending on the network used). Because of this, not putting the server on for at least 72 hours meant a loss of data. In addition, there were work culture issues; it appeared that coming into the office daily for the state HMIS officer was a challenge as the work culture was lax. The challenges with a poor work culture in the Nigerian civil service are well documented elsewhere in literature (53; 54). It also was observed that the server was poorly maintained. The server was tampered with; for example, the SMS modem driver was uninstalled occasionally and improperly reinstalled, or reconfigured for Internet use. Because of these issues, reporting rates fell by 75%. By the seventh month, data reports received were only 25% of the total, of which half were lost because of inadvertent deletions/disruptions by the State HMIS staff.

The next plan of action was to increase server stability and security by dedicating the server for use for only the mobile project; restricting use by setting and frequently changing passwords. This prevented unauthorized use by outsiders. Improving the power solution was attempted by advocating for increased funding for fuel (for the HMIS office generator), but this did not yield much because budgeting was done in another division (outside the HMIS) and it was difficult to adapt to exigencies. At that time, the budget for the year had not been signed into law. The lack of a budget by the State HMIS precluded other options such as procuring inverters and/or rechargeable dry cell batteries, using solar panel systems or even acquiring another server to run as a backup, a parallel server or a middle tier gateway. In summary, many of the technical options were not possible and the bureaucratic nature of work did not permit much flexibility around the issues.

As the process of salvaging the situation continued, the period of funding for the mobile project by the NGO elapsed, but the team continued with the training of HMIS staff on data analysis, presentation and use. However, on evaluation, despite issues with the server at the ministry, the project was considered by many users in the facilities, districts and the state as a huge success, because it successfully demonstrated that even in the remotest of places, timely and good quality

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data collection was possible. Consequently, demands increased from other health organizations in the state for the system to be replicated in their organizations. In addition, the districts requested to host their own servers.

Conflicting Logics

Conflicting logics can be observed here. On one hand was the logic for physical “ownership” and physical control of the server as a requirement for sustainability in the long-term. On the other was the implementation team’s technical rationality for objectively improving the data collection system, irrespective of server location or approach. The choice appeared to be between having an externally hosted system (either within the country or outside the country) that performed well, or having an internally hosted (and MoH owned) system that was dysfunctional or, at best, difficult to maintain.

During the evaluation, a pertinent issue arose. It was considered inappropriate (by the districts) for the pilot facilities to submit data directly to the since the dominant decentralization logic for primary health care held that districts needed to manage and utilize data collected within their communities. Furthermore, it was considered important to strengthen the districts, rather than bypass them when health facilities send data. This came up in discussions with the various districts. As one of the district managers said, “the system is not well structured. No district will accept a system where the health facilities report directly to the, bypassing them?”. According to one of the state managers, "It is important for districts to receive and analyze all the data sent from facilities in their geopolitical areas, districts should have their own modem and run the server. They should have more capacity than simply sending data from the mobile." The districts wanted their own servers so that they could also receive data from the health facilities, after which they would submit summaries to the state. However, with the ministry unable to handle the server, the districts were considered even less capable. It was argued that the districts were unable to maintain their desktop systems let alone handle SMS servers.

This can be seen as a conflict between the logic of bureaucratic hierarchy with the need to maintain the existing power and control structure by the districts, and the efficient but network-centric logic of new networked technologies such as mobile technology. Having a central server where all data were submitted from health facilities leading to bypassing the district level appeared to be in tension with the hierarchical structure of the HMIS institution. This network-centric logic versus hierarchical organization logic is an important one. Additionally, related to this was a conflict between the decentralization and centralization logic. This is because a key rationality in public health is decentralization (68-77), such that modes of work that introduce centralized data collection are likely to encounter some tensions. This was exemplified by the districts asking to host or at least control aspects of the system. These related conflicts set the stage for the next phase, involving centralizing the server but decentralizing control and access.

Phase 4: Resolving Conflicts – Decentralizing Access using Mobile Modems and web-based DHIS2

Based on a review of the aforementioned conflicts, the challenge was framed as questions of balance. For example, how could the system be locally owned yet performing efficiently and

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reliably? How could the centralized collection system permit decentralized control by the districts? How could the network-centric technology support the strongly hierarchical nature of work within the State HMIS?

The solution proposed was to embed control into the information system such that the server was remotely hosted yet controlled by the states and districts through administrative access, restricted based on their roles and area of coverage. Fortunately, there was a new DHIS system (DHIS version 2), which was Web-based and permitted the districts to access and assess activities from the health facilities that fell under their hierarchy. In addition, at this time the telecommunication companies in Nigeria were in a price war over mobile Internet market dominance. This led to a price crash on mobile Internet modems, making them cheap enough for the NGO and the ministry to consider. The thinking was that being able to situate the server on the Internet (for centralized management) would be desirable to the districts, which all wanted distributed access and control of their hierarchy (for decentralized control).

In line with this, a DHIS2 server was configured and installed for Katsina and mobile Internet modems as well as notebook computers were provided for all of the district health offices. Data forms also were migrated from the DHIS 1.4 (MS Access-based system) to the new Web-based system.

The migration to the Web-based DHIS hosted in the cloud retained the advantages of the mobile system. For example, the issues with the difficulty in transportation that the mobile phones were intended to solve were similarly solved, as data transfers could be possible from the districts through the mobile Internet modems. The new DHIS 2 also came with a built-in mobile Web interface as well as a GPRS-based client. This meant that issues with the SMS short storage could be averted. In addition, it helped to spread the coverage of the HMIS to all the districts (as the mobile did) but also relieved the State HMIS of server maintenance work.

In sum, this approach allowed the resolution of a couple of conflicting logics. The centralization-decentralization tension was resolved by allowing decentralized control within a centrally managed information system. However, the network-centric versus hierarchical organization tension has continued to be a challenge. Nevertheless, a step towards resolving or ameliorating it has been to emphasize the supervision of local health facilities by their districts, using the hosted DHIS. For example, Web reports can be reviewed and approved through data review meetings, and reports printed from the DHIS2 application are forming the foundation for continuing the tradition of the HMIS' hierarchical workflow. In general, the state and the districts were satisfied with being able to have distributed access to data as well as monitoring and supervising health facilities. This was due to the centralized web-based management and the ease of keeping up with modifications and submission from the different districts and facilities.

However, with the dependence on the Internet by the new Web-based HMIS and the unequal distribution of quality mobile Internet access across the districts, issues of universal coverage and equity were again becoming a concern, especially from the districts with poorer access. Universal coverage and equity are foundational logics in public health, and a key aspect of what defines success within the HMIS context. These emerging conflicts will (again) need to be navigated as the project continues to evolve. Universal and equitable coverage of the state was a

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motivation for the transition from the sentinel system to the HMIS in earlier phases of the project. Therefore, it appears that it has manifested in another form in this later stage.

Analytical Summary of Findings

The preceding description with analytical insights has followed the evolution of an HMIS implementation within a challenging context, highlighting the interplay between the technological solution, the institutional arrangements and stakeholder perspectives. It has exposed multiple institutional logics including where they conflicted, how they shaped the implementation process, and how they were resolved were possible.

Figure 3 below is a case dynamics matrix (41) showing the challenges and the actions planned and taken in each phase. Included are highlights of the dominant institutional logics and conflicts in each phase of the project.

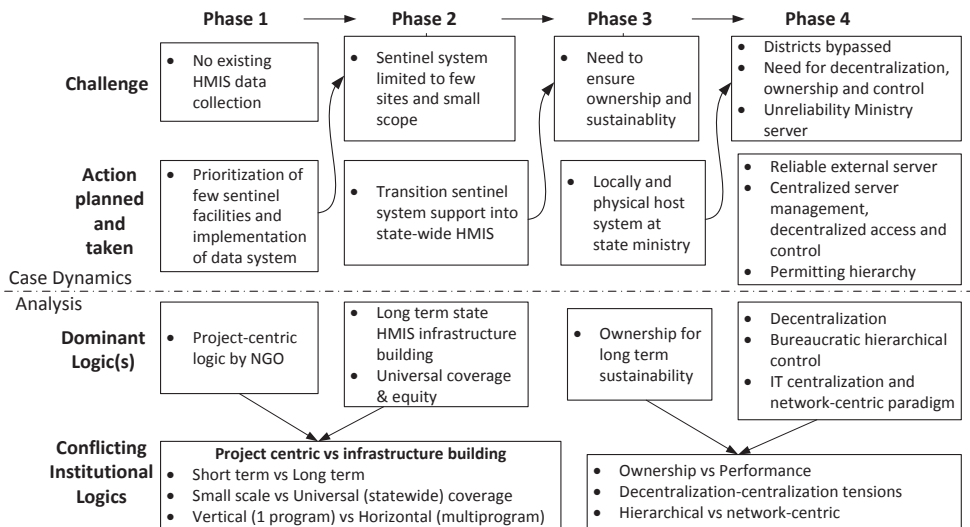


Figure 3. Case dynamics matrix showing the dynamics of the case

Discussion

This case has three major analytical findings: Firstly, it revealed the institutional logics that played a role in the HMIS implementation process; secondly, it highlighted how the evolution of the implementation through the action research is fueled by conflicting logics and the drive to resolve them; lastly, it highlighted the approaches for resolving these conflicts. I discuss these three aspects briefly.

Institutional logics in the HMIS

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This study has highlighted institutional logics that are some of the most fundamental logics in HMIS implementation. This claim is substantiated by the fact that previous researchers have highlighted the role and importance of these logics in shaping other cases of HMIS implementation, especially in the context of developing countries. For example, the short term project-centric quick win logic in NGO internationally funded projects has been exemplified and discussed by many researchers (21; 55; 56). Avgerou, for instance, highlights this project-based rationality when she discusses a similar case of international donor-led HMIS implementation in the Jordanian public health sector (21). Other researchers have followed this through from the perspective of sustainability and describe how HMIS projects are driven by the fundamental logic of sustainability (57–62). A dominant logic linked to this is that sustainability can be achieved through local ownership of implemented HMIS systems (63–66). Along the same lines, HMIS implementers and researchers have emphasized the logic of local control extensively discussed as decentralization (56; 67–77). Furthermore, the institutional logic of universal coverage, which we saw as translating to the need for state-wide coverage of the HMIS, is one that has been described as “the single most powerful concept that public health has to offer” (78) and one that requires HMIS to scale (79). Additionally, other HMIS cases have described the institutional logic of rigid bureaucracy and maintaining hierarchical power structures (19). Less reported though has been the logic of network-centric organization (80–83) where network technologies such as Web and mobile-based HMIS disrupt existing power structures because they allow more communication. Overall, using the case, the author exemplifies and identifies what can be considered as foundational logics of which HMIS implementation planners and designers need to be concerned and aware.

Conflicting Logics

Perhaps, even more important to recognize is that fundamentally, these logics sometimes conflict, thereby increasing the risk of implementation failure (2). However, conflicting logics can be a major enabler and driver for organizational change processes (6). The case described here suggests that the challenges and reactions in each phase were motivated by the need to resolve conflicting logics that emerged from the previous phase. In this way, conflicting logics can be seen as enablers and drivers for an implementation’s change process. Identifying the conflicts that arose within the implementation process was a key problem-solving step, as well as an important change management process for the implementation. Thus, I agree with researchers (17; 19; 84) who contend that identifying these logics is a major step towards improving implementations. This case provides examples of conflicting logics that implementers can watch for in HMIS implementation (see Figure 3 above and Table 2 below). These conflicting logics appear consistent with prior research. For example, some researchers (85, 86) have similarly emphasized conflicting institutional logics arising between a project’s short term quick win focus and a long-term infrastructure-building perspective, similar to the issue here between the NGO’s initial quick win focus and the state’s long range focus. The conflict between focusing small scale and going large scale is crystallized in the struggle between running pilot projects that then struggle to scale in line with the goals for universal coverage (3; 87). This was also the situation in the Jordanian HMIS case (21). The third conflict — between focusing on small/vertical scope (one disease) or focusing broadly on the larger primary health system (broad horizontal scope) is also supported in HMIS literature (88–90). The conflict between ownership and performance is one that has been a bane of many HMIS projects in developing countries, such that the goal of

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local ownership often ruins the objective of performance where the capacity for maintaining the performance is unavailable (91; 92). The other issues from this case on balancing decentralization-centralization (68; 70; 77; 93–96) and the conflict between hierarchical vs. network-centric logics (81; 82; 97) are also important reported HMIS concerns.

Table 2 below is a succinct summary of these conflicting logics and how they were resolved. The resolution strategies are discussed below.

Table 2. Conflicting institutional logics, examples from the case and resolution strategy.

Conflicting institutional logics	Example from case	Resolution strategy	Type of resolution
Short term vs. long term	Quick win sentinel system vs. long term HMIS building	Transitioned from short term thinking to long term	Transitional resolution
Small scale vs. Universal scale	Sentinel system in only 14 facilities vs. statewide HMIS in all districts	Transitioned from sentinel system to statewide HMIS	Transitional resolution
Vertical (program) vs. horizontal (whole systems)	Immunization-focused sentinel system vs. HMIS focused on broad scope of primary health care	Transitioned from vertical immunization system to broad HMIS	Transitional resolution
Ownership vs. Performance	Locally 'owned' and (state) hosted server performed poorly, while externally hosted server performed well	Found a balance: A locally controlled Internet server satisfied both local ownership and gave good performance	Dialectical resolution
Hierarchical vs. network-centric	Submissions from facilities over the mobile network bypassed the districts disrupting existing hierarchical structure	Found a balance: Districts have access to data from facilities and have sufficient power to assess/approve data for facilities under them	Dialectical resolution
Decentralization-centralization	Centralized state server vs. districts wanting to host their own server and achieve control of health facilities	A balance: Centralized Internet-based server management actually helped decentralize access and control	Dialectical resolution

Resolving Conflicting Logics

The third set of analytical findings relate to how conflicting logics were resolved. Understanding the resolution of these conflicts has been a major concern for practitioners and researchers (5; 6; 19; 98; 99). Largely, the existing literature points to deinstitutionalization. However, this paper suggests that there are alternative strategies. Deinstitutionalization refers to the process by which institutional logics erode and disappear (25). Particularly, Sahay et al (19) have used this to explain how the logic of paper use in the Tajikistan HMIS was deinstitutionalized (or removed) through the introduction of computer-based HMIS. In our case, the changeover from the short-term sentinel focus to a broad, 'universal coverage'-seeking approach involved changing from one dominant logic to another. Rather than describe this as the total removal (deinstitutionalization) of an institutional logic, it appears more appropriate to see it simply as conflict resolution through switching the project from one logic to the other without necessarily destroying the other logic, which, perhaps, continues to exist elsewhere. I have termed this approach to resolving conflicting logics as *changeover-resolution*. It can be understood better when seen in contrast to another approach I have termed *dialectical resolution*, which often occurs when resolution occurs not through changeover but by balancing two competing interests. For example, in this case, by centralizing the mobile server management on the Internet (phase 4), the implementation decentralized access to the server, balancing and creatively combining both centralization and decentralization. The conflict was not resolved by changing from one logic to another, but rather by synthesizing both sides and finding a combinational balance. Thus, dialectical resolution involves mindfully balancing between competing logics rather than taking them as if in a black-white dichotomy. A more extensive discussion of dialectics can be gleaned from the literature (28; 30; 33; 100).

An inference for practice is that implementers need to look out for conflicts and build bridges between them. These bridges could take different forms: either a bridge that permits a changeover-resolution, or a bridge that permits the marriage between two sides (dialectical resolution). The third strategy - deinstitutionalization - appears to be an approach to building a bridge to allow crossover, and then burning one side of the bridge in attempt to exterminate one logic. In sum, this paper proposes an understanding of the resolution of conflicting institutional logics as consisting of three possible strategies - deinstitutionalization, changeover resolution (logical switching/transition) and dialectical resolution (see summary in table 3 below).

Table 3. Three strategies for handling conflicting institutional logics

Deinstitutionalization (as in Sahay et al. (19))	Changeover resolution (as proposed in this paper)	Dialectical resolution (as described in this paper)
When one logic needs to be obliterated, to give way to a new paradigm	When actors need to focus on one logic, and compromise the other (not necessarily obliterate it)	The conflicting logics need to be both adopted and combined within the implementation

Further Implications

In this section, I summarize the implications of the analysis for HMIS practice and research and outline the contributions made to institutional logics research.

Looking back at the approach and setting of this study, like other context-sensitive studies, generalization from this single case has the risk of being weak or limited. However, as I have shown in the preceding sections with numerous references to previous research, this case is typical of HMIS implementation in developing countries. The findings and the interpretations I have made from this case clearly sit well within the framework of previous studies and the body of literature, and there is substantial support for taking these broadly, in a way reusable and applicable to similar situations. Building on this, the analysis has implications not just for HMIS implementation in Nigeria but also similar contexts where conflicting institutional logics play a role.

Many HMIS implementations, by virtue of involving multiple actors and interests, will involve an interaction of many institutional logics with some conflicting in the implementation process. From a practical perspective, implementers need to take these logics more seriously. The analysis of this case sensitizes us to the role that conflicting institutional logics play by increasing the risk of project failure, when not resolved. This is particularly important as success or failure often is constructed by the actors and through the logic with which they perceive the implementation process. Therefore, it appears that for implementations to be successful, implementers may need to negotiate and navigate the different logics of the participating actors. In cases where these negotiations were not possible e.g. in the cases described by Silva and Hirschheim (101), Avgerou (21) and Kaduruwane (92), the implementation was unsuccessful. In developing countries, especially with limited resources, if we can improve in the negotiation of the conflicting logics that arise in implementations, we may significantly improve the implementation of HMIS, and improve health systems and foster socioeconomic development down the line.

In relation to the foregoing, another implication is that HMIS, and by extension, information system design and development within the context of conflicting logics, may need to be done in ways that support the transition between logics or in ways that support the coexistence of multiple logics. In the case discussed here, the ability to navigate the different logics was partly because of the flexibility of the information system and how it could differentially support multiple, and even conflicting, logics.

In conclusion, through the application of the notion of institutional logics and its related concepts, this paper has extended our understanding of HMIS implementation. The paper has typified the institutional logics involved in HMIS implementation, including where they may conflict. In addition, it has expanded our understanding of mechanisms for resolving implementation conflicts – by proposing the concepts of changeover resolution and dialectical resolution, as an addition to the existing concept of deinstitutionalization. I reckon that these are pertinent contributions, and it may be beneficial for researchers to extend these concepts further and broaden our understanding in other contexts.

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While HMIS implementation generally is seen as a difficult and complex process, I believe that understanding the dominant and conflicting logics at play can provide implementers with deep insight into aspects to examine when performing needs and situational analyses, as well as when developing implementation and change management strategies. This paper has already highlighted some of the logics that should be considered – e.g. the need for decentralization, hierarchy and centralization, long-term sustainability, ownership, universal coverage (and scale up) and short-term project focus - and the conflicts that may arise between them. Preempting and planning for these may enhance the prospects of HMIS implementation success, especially in developing country MoH contexts.

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The Emergence of Mobile-Supported National Health Information Systems in Developing Countries

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Abstract

A major challenge for national health information systems in developing countries is their scalability and sustainability at the lowest levels where primary health care is delivered. This paper contributes to the discourse on how national health information systems can scale to the lower levels and how mobile technology is supporting the collection, handling and dissemination of data. But can mHealth go beyond the 'hype' and visions it has come to be associated with? Using an action research methodology in a long-term action research project, the usability and then scalability of mobile solutions for large scale national health information systems are studied. In this paper, initial successes and challenges with using m-Health for national public health information systems is reported and discussed.

Keywords:

Mobile, Health, Information system, Nigeria, India

Introduction

Health information systems (HIS) are having a major and ongoing impact on the lives of people in both low and high resource settings. A robust health information system is a basic foundation of public health [1]. The achievement of the health-related Millennium Development Goals (MDGs) will depend upon the effectiveness and efficiency of health systems. HIS remains the backbone for providing information to track progress for improving and strengthening the different health system components and monitoring the MDG goals. On the ground, however, HIS development in developing countries has proven to be difficult due to organizational complexity, fragmentation, lack of coordinated organizational structures (that maintain disparate information systems), unrealistic ambitions, and more generally due to the problem of sustainability. Poor availability and quality of data and a resultant poor knowledge and "culture" of use of information for planning and decision-making characterize HIS in many countries. Importantly, poor physical infrastructure has remained a serious obstacle in ensuring an efficient health information infrastructure in many developing countries.

The world over, both within the domains of research and practice, there is an increasing recognition of the role mobile tech-

nology and mobile phones can play in supporting public health systems. There is an emerging field and research domain for the application of mobile technology for health, mHealth. Mobile phones have a particular status across all developing countries. There are 2.2 billion mobile phones in the developing world, compared to 305 million computers and only 11 million hospital beds [2]. Between the end of 2007 and the end of 2008, mobile phone subscriptions increased by approximately 1 billion [3]. Mobile technology comes with the unique potential that it has already become a routine part of most peoples' everyday lives. It is becoming increasingly affordable and accessible, and has the required infrastructure (for example, the network coverage) even in villages to support its easy use and maintenance.

There are over 4 billion mobile phones, 64% of which is in the developing world [4]. The majority of the mobile subscribers are now outside the major cities and wealthiest states. For example in India there are 65 times more mobile connections than Internet connections [4]. This creates opportunities to use mobile phones to capture data at the source, thus removing significant sources of data quality problems usually associated with manual transfer of data between paper reports. In addition the aim is to use mobile phones as a channel for feedback to the community health workers. We explore to what extent this technology can be used for effective data exchange and communication in public health; how mobile phones in general can secure routine health data as well as stimulate better health provision by better communication and training. A major concern is how mobile phones can be coupled to and leverage district health information systems.

In this paper we discuss the emergence of mobile-supported national health information systems in developing countries by describing two ongoing mobile health projects in Nigeria and India. The mobile solution will also be described and discussed.

mHealth Applications

There are numerous mHealth projects in developing settings: the alliance of UN, Rockefeller & Vodafone in Feb 2009 formed after e-Health ideas exchanged in Rockefeller's Bellaio Conference (UN Foundation, m-Health Alliance) [5]; Using Mobile Phones and RapidSMS to Improve Child Nutrition Surveillance in Malawi (UNICEF, Govt. of Malawi and Mo-

mobile Development Solutions) [6]; SIMPill – embedded mobile phone chip in medicine bottle to remind patients in South Africa (2007). 90% took TB medicine while earlier only 22%-60% took it; mHealth for Development paper, 2009) [7]; Text-to-Change – Sends HIV awareness messages in Uganda [8]; Cell-Preven. Health workers use mobile phones to send SMS messages with real-time data on symptoms experienced by clinical trial participants, enabling immediate response to adverse symptoms [9]; Frontline-SMS – a bulk SMS solution [10]; OpenRosa [11].

Generally, m-Health projects can be broadly discussed according to: technology, domain area of application, the hierarchical level in the data flow; and data handling processes it is used for.

By technology, m-Health applications can involve SMS (Short Message Service) or 'texting', voice services and other packet data services such as WAP, GPRS, etc. These can be simple typed SMS from any phone; coded SMS texts (following some predefined logic (which gets interpreted at a central server); or SMS-based data transfer from applications (J2ME, Android, etc) installed on the phone. WAP and GPRS have been little used in the settings we are concerned with in this paper for the reason of unreliability (at this time).

By domain, m-Health has been applied to various health areas including maternal and child health, community health volunteering support, immunization, general emergencies, monitoring of patients with illnesses such as HIV/AIDS, supporting the control of diseases such as malaria, etc.

In this study, the focus is on mobile systems feeding routine data from the lowest levels where they are produced such as communities and health facilities, through different levels up to the national trunk. In this scenario, facility/community level datasets are transmitted to upper levels through the state to the country warehouse, with health information defining a whole range of data elements spanning from utilization data, maternal and child health data, mortalities, nutrition and disease surveillance data. In developing countries, the collection of such data has historically proven to be intractable.

Most mHealth applications are in the piloting phase. A community of practice for mHealth is still being developed and mHealth standards are yet to be developed. This paper thus reports on a significant phenomenon, the emergence and early institutionalization of mobile systems for routine data collection, with data flowing from the lowest levels to the national level.

Materials and Methods

Our research approach is action-oriented and interpretative and characterized as a 'network of action' methodology. The network of action approach is based on the principle of creating learning and innovation through multiple sites of action and use, and sharing these experiences vertically and horizontally in the network [12, 13]. It is premised on collective action where connected research units are able to share experiences and learning. The cases presented here are derived from units (or nodes) within the Health Information System Programme

(HISP) network of action. The authors are actively engaged in these units (HISP-Nigeria and HISP-India) which are, with their respective partners, the principal development partners for this system in their respective countries. The pilot in India started in February 2009 and is ongoing. While that in Nigeria started in July 2009 and is ongoing. However, these pilots are converting into full-blown deployments and installations as the rate of adoption has been tremendous. Data sources for this study have been primary and secondary. Primary sources have included notes from participant observations, performing training, and formal interviews with health workers at different levels as well as administrative and technical personnel. The authors have also been involved in the iterative development of the solution. Secondary sources included formal reports from the projects highlighted.

Cases

Here two cases are presented which are significant by virtue of being based in the national system of two very populous and complex countries in Africa and Asia – Nigeria and India respectively.

The Nigerian Case

With a population of over 148 million people [14], Nigeria is the largest country in Africa and accounts for about half of West Africa's population [15]. Health service delivery is largely a government function and as in all countries, the establishment of a robust national information system is a priority. Though the HMIS framework was articulated (in 1992) and implementation commenced (in 1997) in a number of states, the HMIS is only recently (2003) beginning to be institutionalized [16]. This recent strengthening efforts (mainly donor-led) can be attributed to increased demand to show progress towards attaining the MDGs. Since 2003, a free and open source data warehouse solution, the District Health Information System (DHIS) [17] has been implemented at the national and state levels. However, a recent situational analysis has revealed the very low base from which the HMIS is being developed. Computer equipment is usually either in short supply or poorly maintained where it exists. Power supply is very poor; and transportation through long distances and from hard-to-reach areas is difficult. Data use is almost non-existent at all levels of the system. Reports are submitted late and data quality is poor in the HMIS.

It is in this premise and following from the observation that the mobile networks have greatly improved that this study is set. The application of mobile technology has a huge potential for circumventing the aforementioned challenges and improving data reporting. At the time of independence in 1960, Nigeria had a population of about 45 million people with 18,724 functioning fixed telephone lines - a tele-density ratio of 0.04 telephones per 100 people [18]. At the commencement of mobile telephony in 2001, there were only a few thousand lines available from the operators and services were too expensive for the average Nigerian. By 2002, the number of mobile subscribers stood at 1.5 million and prices fell [19]. By the end of 2004, the GSM operators had recorded well over seven mil-

lion subscribers, which was a real explosion when compared with about half a million working lines from NITEL in 2001 and is now reaching 60% penetration [20]. This shows that Nigerian telecommunication industries experienced rapid growth in terms of usage and subscription. By 2007, there were 34 million telephone lines with 1,670,767 fixed lines and 32,265,827 mobile phones in Nigeria [21].

This study thus set out to explore the possibilities with using mobile phones for communication of data from health facilities as well as at the local government area (LGA) level. A simple form-like data collection tool on mobile phones was developed for transmission of data securely and timely. The pilot was tested in 2 states, Katsina and Yobe in Northern Nigeria. This region is characterized by extremely low levels of health service utilisation, the existence of polio and measles outbreaks, low staffing levels and low skill levels of existing staff, absence of significant technology other than mobile coverage. It involved health workers in 26 busy facilities and 34 local government area Monitoring & Evaluation office thus covering the whole state of the Katsina and parts of Yobe.

Findings

A major finding was that the application was well received. As one of the state resource persons said, "let us not call this a pilot because it is bringing very useful results and is now part of the system". With this rapid adoption at facility, LGA and state levels, came specific interests in the sustainability of the system. Facility workers were concerned that they did not understand the data elements properly. The data elements used in the system were from the national standard for facility but they had not been properly trained on it. The implementers therefore had to do training on the data collection and what the elements mean. The LGA officers were particularly interested in an increase in the datasets collected particularly the addition of the full complement of disease surveillance reports. The state level officers were more concerned about the ability of the tool to strengthen the LGAs. As one expressed, "I am sure you have tested it elsewhere. Let us think of how to improve it and include other relevant data elements that the LGAs also need very much". Thus, the rapid adoption and acceptance of the mobile system led to an early discussion by stakeholders at different levels to improve it. These improvements have occurred at a rapid pace when compared to the DHIS computer-based installations. This is attributed to the fact that the mobile application is seen by many users (network effect) and its ease of use has allowed the health workers to be more engaged in data capture.

The Indian Case

India has more diversity within its border than any other country and its population of 1.1 billion people lives and work in very different circumstances and geographies. The mobile penetration is 30% and is the fastest growing market in the world.

The Society for Health Information System (HISP India) [22] which has more than 10 years experience of working with health information systems in India, and are developing and implementing the District Health Information System (DHIS)

software for health management that is currently being deployed in almost all states in India to support sub district data registration and analysis activities, and is integrated with the national database through the Ministry of Health web portal. The DHIS deals with aggregated (non-patient) data collection and analysis in an integrated manner across health programs, including important monitoring of MDG 4 and 5 indicators.

Implementing software solutions at the lower levels of the Indian health system is a huge undertaking due to its enormous scale in terms of the vast number of installations, system maintenance and training activities. A mobile solution to strengthen the work of community health workers need to be coordinated and supported by backbone systems e.g. to produce the mobile collection forms, to store, process and report the data collected by mobile phones, and generate work schedules and feedback reports back to the mobile clients. The strategy was to install such a backbone system at the Block PHC level as lower levels is hard to computerize, and link the transmission of data from the mobile (such as through a SMS) to this backbone.

A pilot project was initiated by National Health System Resource Centre in India in collaboration with HISP India. Health workers in facilities at the lowest level were provided with a tool to report routine data to the district and state level through the DHIS. The mobile application for sub-centre reporting was piloted in 5 states: Kerala, Rajasthan, Gujarat, Himachal Pradesh and Nagaland. 189 health workers were given mobiles for reporting.

Findings

After 6 months the results are very promising. Data is reported and 100% said they prefer this way of reporting as it saves time – they do not need to travel to report – and it is more efficient. The role of social networks has appeared in several ways as one users supports the other. Introducing mobile phones among health workers have changed the communication patterns and seems to go beyond what used to be hierarchical borders. For instance, an HMIS manager now could contact directly the health worker and vice versa. Earlier he/she had to send a written request to the PHC to get them to contact the health worker, for instance, to invite for a meeting. The work related communication increased and 88% said they had called other health officers for help and 85 % said they had contacted doctors for medical help in case of emergency. Introducing mobiles into public health is not only about introducing a tool for data capturing but it seems have the potential of changing the way of working and communicating which can have great effect on health provisioning.

The Application

In Nigeria and India, an open source Java-based mobile platform was built on the already existing DHIS-based national health information infrastructure. The solution consisted of a native Java mobile application installed on a mobile phone and a server gateway that plugged into the DHIS data warehouse (See Figure 1 below). In Nigeria, the mobile application was developed based on the existing national HMIS facility forms and implemented at the facility and district levels. In India, it

was based on the national HIS form for (ANM) coordinated by the National Rural Health Mission.

The application was designed to support the health workers in the filling and sending of the reports through the mobile phone. It is based on free and open software development facilitated by a commons-based production network established between developers in the HISP network.

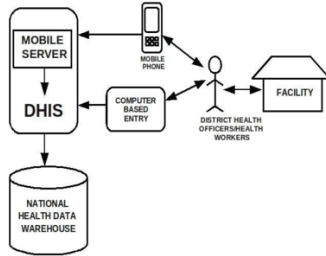


Figure 1 - An illustration of the mobile-supported health information infrastructure

The application allows for data entry based on period (e.g. by month) and by (sub-centre or health facility). Data elements collected are those for **antenatal care and pregnancy outcome, mortalities and births, family planning, immunization, nutrition and growth monitoring, community outreach services and facility utilization**. In designing the application, mobile network coverage fluctuations typical of such settings were considered. Data is stored on the phone using basic Record Management Store (RMS) functionality. This allows data to be stored on the phone and forwarded when reception of the mobile network returns. It thus allows for the retrieval of previously filled reports. Technically, it is a J2ME application utilizing only the basic Java functionality (MIDP 2.0 and CLDC 1.1) functionalities and it can be installed on very low end phones.

Discussions

The emergence of mHealth applications and projects is a significant phenomenon – not only because of a fast rate of adoption but also the ability to achieve instant results with data handling. This can be attributed to the relatively small means with which the important issue of the lack of quality data can be addressed. In short, mobile technology provides a fundamental leverage that had been lacking in these settings – a network infrastructure for electronic data transmission. This, combined with the ease of use of mobiles compared to computers, has allowed many applications of mobile technology to emerge. It is important to note that; as this is a relatively new phenomenon, it may be too early to discuss with precision the possible success rates. But it is an important question to ask if these will translate to institutionalized systems for large-scale national systems. We have found that this is the case - mobile phones have been adopted for the day-to-day work of data handling in cases of Nigeria and India.

In leveraging the mobile technology and infrastructure, there are inter-related challenges that have been encountered. We discuss these as use-oriented, technical and sociopolitical.

The introduction of mobile phones among health workers has changed their communication patterns and has led to a challenge of the hierarchical borders and bureaucratic protocols often associated with public work routines. Health workers can be contacted directly by the state bypassing levels in the data flow but allowing for rapid exchange of information.

In addition, mobile health solutions for national health data systems suffer from being coupled to an underlying installed base. This can have consequences if such underlying base is problematic and poorly functioning. It was seen that the introduction of the mobile solution made existing problems with the underlying system more transparent and addressed. This happened in the Nigerian case where the national reports were not well known due to lack of forms and the lack of competence to use them. The phone thus provided a 'window' into the operation of the system and allowed quick corrections to be made. In both countries, the mobile application was found to be an effective tool for training the health workers on the meaning of the data elements.

Planning and involving stakeholders – expectations are difficult to define as requirements were desperately varied. By growing the system gradually, we have found that stakeholders could be involved gradually and more easily. Cost of SMS has been an issue in Nigeria since the prices are much higher in Nigeria than India which has among the lowest prices in the world.

The phones are costly and the question of who shall own the phones arose. The challenge that people could lose them or sell them is there. In India we saw that the phones were very well taken care of and seen as very valuable for them individually. In a case where a phone was stolen, the health worker was able to negotiate the phone back with help from the community by paying 500 rupees (5 USD).

The fear of deleting the application as happened in India could be solved by installing the application in mobile chip memory, but we have seen that there are frequent changes to application so flexibility is more important. As such, an over-the-air (OTA) approach is advised. We observed that only low-level phones are purchased for personal use and it is difficult to leverage robust applications on such. For example, in Nigeria in one of the states piloted, only two of the district health information officer surveyed had a Java-enabled phone. The phones found were mainly cheap Chinese-made phones. This implies that funds are needed to fully utilize the user friendliness of mobile application.

By adopting the 'the low-end phones' approach, the risk of phones being stolen is reduced, more phones could be purchased and scalability thus more easily achieved, especially when compared to deploying relatively expensive personal digital assistants (PDAs) and smart phones. In situations where only few data elements will be collected, where there are low funds or where the number of users is staggering (e.g. in the thousands), pure (typed) SMS solutions such as Frontline-SMS

may be advisable. Such systems may not be advised for forms with many data elements to ensure high levels of data quality. The cost of the phones therefore has been a concern when planning for scaling. There are ongoing negotiations with manufacturers in this regard.

Conclusion

m-Health support for public health systems is being institutionalized in developing countries. The rapid adoption and gradual institutionalization is partly due to the individual acceptance and familiarity with the mobile application as a standard tool for data collection and dissemination. However, beyond the mobile phone as a standalone device there is a systems perspective observing the other components and kinds of infrastructure – such as the paper registers at the facilities, the computers at the district levels, the networks and the servers at the state level, and also the basic infrastructure required to support the mobile phone use (charging facilities, support, network coverage etc). Mobile applications can be sensitively designed and introduced, so as to support the development of an ‘integrated mobile supported health information infrastructure’ in developing countries.

Future work would explore the incorporation of improved technologies (GPRS and X-forms) as well the role of social networking in supporting mobile-supported networks.

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Improving the Routine HMIS in Nigeria through Mobile Technology for Community Data Collection

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Abstract. Decision makers in many developing countries lack the required data needed for evidence-based health management. One reason for this is that the routine national health management information systems (HMIS) do not extend to the 'last mile', the communities and the informal setting of villages, where a significant proportion of health events occur. Community-based HMIS data collection is often either poor, or non-existent, in low resource settings. Efforts at establishing community-based HMIS in the past have often failed, or at best, become dysfunctional, beset by challenges with supporting infrastructure such as erratic power supply, poor road transportation and poor telecommunication. However, the advent of mobile technology with its increasing penetration into the rural areas has permitted a re-envisioning and redesign of HMIS data collection. The study described in this paper presents lessons from the application of mobile technology to the collection of data from households and individuals, with the aim of improving the routine HMIS. It utilized a participatory action research approach; and was carried out in Cross River State in Southern Nigeria. The paper makes three major contributions. Firstly, it briefly describes the context and operations of a mobile-based community data collection system designed and implemented to provide high quality health and demographic data for the national HMIS. Secondly, it details organizational mechanisms by which the application of mobile technology reduces the difficulty of data collection from communities and districts, thus strengthening the district-based national health information system. Thirdly, the paper points to emerging challenges and areas for further research. Overall, evidence from the research suggests mechanisms by which mHealth data collection improves the HMIS organization, through savings in organizational resources, increases in information quality and in organizational efficiency (technology as an occasion to restructure) as well as in creating new possibilities for institutionalized HMIS data collection.

Keywords. HMIS, mHealth, mobile technology, community, data collection, developing countries, Nigeria

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1. Introduction

Health management information systems (HMIS) are an essential foundation for evidence-based decision-making within public health systems. However, most HMIS in developing countries² are inadequate in supporting their public health systems as they fail to generate the high quality (timely, complete, accurate and consistent) data needed to support decision-making activities such as health planning [1–3]. Specifically, many HMIS in developing countries do not extend beyond the large health facilities to the ‘last mile’, the communities and the informal setting of villages, where a significant proportion of health-related events occur [4,5]. Consequently, the HMIS data often represents only a tip of the iceberg, missing a substantial amount of important health and demographic events in the communities [6–8]. Efforts at monitoring events within communities in developing countries have often failed, or at best become dysfunctional, beset by poor supporting infrastructure such as erratic power supply, poor road transportation and poor telecommunication as well as a general lack of context-appropriate technology [7]. Consequently, community-based HMIS data collection is often poor, or nonexistent, in such low resource settings. This is the case in Nigeria, the context for this paper, where the Ministry of Health (MoH) has described the HMIS, including its community data collection, as “defective” and unable to generate data for “the simplest indicators” [9].

However, the recent rapid progress in the mobile industry, with the increased mobile penetration in the villages, provides an imperative to re-envision HMIS data collection in a way that addresses some of the data collection challenges at the community level. Already, early pilot demonstrations of mobile technology for health-related activities (mHealth) have successfully demonstrated their potential to increase access to healthcare, improve the ability to diagnose and treat diseases, and expand access to health education and training for health workers [10–13]. Nonetheless, most of these pilot demonstrations are generally small pilots with little impact and “often sit outside of the broader government-led district health information systems”, that is, not within institutionalized settings such as the MoHs and the HMIS [14]. Moreover, mHealth practice and research has been mostly technical and computer science oriented, with too little evidence-generating investigation within the broader institutional public health setting [14]. Accordingly, researchers have emphasized the need to understand the possible mechanisms as well as strategies through which mHealth can improve core public health information systems at the level of the community, and by extension, the larger district-based national HMIS [14–16].

The study described in this paper contributes to bridging these identified gaps. Particularly, it makes three contributions. Firstly, it briefly describes the context and operations of a mobile-based community data collection system designed and implemented to provide high quality health and demographic data for the national HMIS. Secondly, it details organizational mechanisms by which the application of mHealth reduces the difficulty of data collection from communities and districts, thus

² Developing countries in this paper refers to the World Bank’s categorization of low and middle income countries. This is discussed in the World Bank’s article on “How We Classify Countries” <http://data.worldbank.org/about/country-classifications>

strengthening the district-based national health information system as a whole. Thirdly, it points to emerging challenges and areas for further research.

2. Research Context and Methodology

The research was conducted in Akpabuyo, one of Cross River State's 18 local government areas (districts). Cross River state is one of Nigeria's thirty six states, lying in its coastal Delta region where it shares the South Eastern border with Cameroon. With a population of about 2.9 million, it is Nigeria's 27th most populous state but the 19th largest with an area of 21,636 km² [17, 18]. It is mainly an agricultural state with about 75% of its people engaging in subsistence agriculture [19]. Recently it has become Nigeria's major tourist attraction and has a GDP per capita of 3150 USD (above the national average). However, over 70% of the population live on under 1.25 USD a day and the state has among Nigeria's worst indices for poverty, food supply, HIV/AIDS, and maternal and child health; and is considered by the Federal Government as an educationally underdeveloped state [19]. Specifically, the implementation focused on Akpabuyo district, which was selected because it had among the poorest health indices (maternal mortality, etc.) within Cross River State. The research was done within the context of the Nigerian Government's commitment to a comprehensive health sector reform that focuses on developing responsive primary health systems at the grassroots - the district and community levels. It was designed and funded within the framework of the Nigeria Evidence-based Health System Initiative (NEHSI). NEHSI is a collaborative initiative developed in the setting of the ongoing Nigerian health reform, and involving multiple partners – including the Nigerian Government's Ministry of Health at national, state and district levels, the IDRC (International Development Research Centre, Canada), the CIDA (Canadian International Development Agency) and two universities (University of Southern Maine, USA and the University of Calabar, Nigeria) [20].

The NEHSI project aims to support the ongoing health reform in Nigeria through “strengthening local monitoring capacity and fostering a strong, action-oriented evidence base towards the establishment and sustenance of a responsive primary health care system” [20]. A major thrust of NEHSI's approach is the development and implementation of community monitoring systems linked to district health information systems, such that they can support the generation and use of evidence on health service delivery at the community and district levels. This research paper is one of many that describe the community-based data collection activities within the NEHSI project. The authors have been directly involved in the design, development and implementation of a community based HMIS. This direct engagement afforded the authors an in-depth experience of the complexity and intricacies that may be associated with implementing mobile-supported HMIS in a low-resource context.

The authors adopted an implementation research approach founded on participatory action research, where they, as researchers, were directly involved in iteratively designing and implementing organizational change (the information system design and implementation), in collaboration with the stakeholders in the organization [21–23]. Particularly, the authors were guided by the research question: Can mobile technology reduce the complexity of community data collection for state and national

health management information systems? And, if yes, by what specific mechanisms? In addition, what are the associated challenges and implications of mobile data collection, and are there any opportunities for future research?

The participatory research approach involved interactions with key players in the communities in Akpabuyo local government (district), field workers, supervisors and data clerks as well as district, state and federal HMIS officers, health managers (including two successive commissioners of health) at the Cross River State MoH, and colleagues at the University of Calabar. Through these interactions, information received from the participants informed our understanding of their perspectives to the project requirements and informed subsequent modifications of the requirements. Data collected was largely qualitative, obtained through participant observation as well as informal discussions, formal meetings and focus group discussions (please see table 1 below). Essentially, in the first phase of the implementation process (2010 to 2011), we held bi-weekly teleconference (Skype) sessions with the participants. This was useful in facilitating the design and implementation process, and allowed seamless communication among collaborators. In the second phase (2012), fieldwork as well as demonstrations and training sessions with state-level MoH staff on the deployed systems were held, proving very valuable in providing feedback.

Table 1. Overview of qualitative data collection

Qualitative method(s)	Frequency or Number of events	Participants (number in brackets)
Participant observation and informal discussions	Daily for a two year period (mid-2010 to mid-2012)	Data entry staff (6), Community field workers (5), Field supervisors (2), Data analyst (1), District HMIS officers (2), State HMIS officer (1), Health managers at national, state and district level (6), District administration (2)
Formal meetings	16 sessions	District HMIS officers (2), State HMIS officer (1), Health managers at national, state and district level (6), District administration (2)
Group discussions	6 sessions	Data entry staff (5), Community field workers (6), Field supervisors (2)

3. The Implemented Solution and Findings

As earlier discussed, the focus of the project was on exploring mobile data collection, especially how it can improve the quality of data collection in the community-based HMIS. By data quality, we refer to the timeliness, consistency and completeness of data. Consistency in HMIS data means that the data corresponds with the reality on the ground. It requires that data is validated and checked to be correct such that it corresponds to previously collected data and with the current population. For example, data collected for pregnancy should not contain males, or females outside the reproductive age. Timeliness requires that relevant reports are drafted, submitted and transferred on schedule. It entails that forms/reports can be filled/generated easily and quickly and can be sent efficiently and swiftly. Completeness requires that adequate information be entered into the right forms/documents and that sufficient data is

collected for the required analysis. It therefore means that all required data fields are filled appropriately.

We found that, while the paper-based system lacked mechanisms to ensure that these criteria were satisfied (other than manual checks); mobile technology could be adapted to meet these criteria and to ensure more consistent, timely and complete data. With mobile devices, it is possible to automatically validate a significant portion of data for consistency as it is entered into the device; and it is possible to check and enforce that data is complete before it is sent; and after filling, to instantaneously transfer the filled data efficiently (using SMS, Wi-Fi or Mobile Internet).

These requirements were fulfilled by our mobile solution, which we built on the OpenDataKit system (ODK)³. The ODK is an android application designed for data collection and transfer. It allows for the design of forms as well as bi-directional data transfer (downloads and uploads) on the field. In addition, two android applications were developed to supplement the ODK application. These two applications provided two functionalities: a drill-down through the hierarchy from the district level through the household level to the individual level as well as functionality for field supervisors to gain access to the system by logging in and viewing on their mobile devices, data submissions (on the server) sent in by field workers⁴.

The application was provided to the community field workers, for download of designed forms, and submission of filled data to the Opendatakit and OpenHDS⁵ (open-source health and demographic system) server at the state capital. The designed forms captured data on births, deaths, migrations, pregnancies, deliveries, immunization and other pertinent health information on households and individuals.

Consistency of data was ensured by allowing the lookup of previous data points (historical individual data), mainly linked to identification numbers (IDs), which had been generated for each individual. Additionally, consistency checks were built into the forms to disallow the entry of invalid data. The application was easy to fill and data could be submitted via the mobile internet while in the field or via Wi-Fi when field workers were back at the office. To ensure completeness of data, forms without appropriate entries in the necessary fields could not be saved or transferred unless they were filled. Through these mechanisms, the mobile solution ensured collection of data of good quality. In addition, linkage of the data to the state/national data grid was achieved through a functionality we built that allowed data export to the state and national HMIS software [24], the District Health Information System (DHIS2)⁶.

³ <http://opendatakit.org/>

⁴ The project webpage on <http://code.google.com/p/crossriver-openhds/wiki/ConfigureMobileApp> presents numerous screenshots of the mobile application

⁵ <http://openhds.rcg.usm.maine.edu/>

⁶ <http://dhis2.org/>

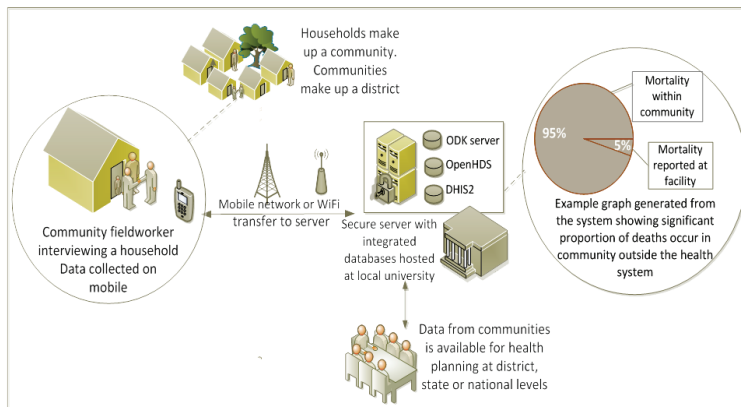


Figure 1. An illustration of the key aspects and concepts of the mobile-supported community data collection for the district-based national HMIS.

Data collection began in early 2011, and by December 2012, the system had registered and followed up on over 5600 people, 1370 households. Among these were over 130 births and 30 deaths that were otherwise mostly missed by the traditional HMIS. In a meeting held with the MoH the data was adjudged as complete and impressive, and the mobile data collection model was adopted for use for data collection across the state. The community field workers and HMIS staff reported that the mobile data collection was easy, friendly and efficient. As one of the fieldworkers commented to a colleague during a discussion session, “The mobile makes our work easier and we do not have carry large reference books. And the great thing is that we can use it when there is no phone network. Just fill in the data and upload it when network signals return.”

Overall, we were able to demonstrate the collection of high quality health data from Akpabuyo and transfer to the state and national HMIS system through the implemented integration with DHIS2. Such a model, if replicated across districts across the country is potentially a game changer for HMIS data collection in the country.

However, migrating from a paper-based to a paperless system was not without challenges. From a change management perspective, it was particularly challenging to transition from a fully paper-based system to a fully mobile-based system. This is partly because processes and practices had to change. For example, in the fully mobile system, the field worker had to learn to use only the mobile device (without carrying paper forms around); and data look up simply used drop-downs instead of the usual stack of paper booklets. The strategy we used was to evolve the system through 3 phases: from the initial paper-based system through a hybrid (combined paper and mobile) phase, and finally to an exclusively mobile system. The (intermediate) hybrid system involved flipping through paper booklets for identification numbers (IDs) for individuals, and other historic information but entering most of the data using the

mobile forms during interviews. Surprisingly, this hybrid system caused more data quality problems than the paper-only and mobile (paperless) system. For example, on analysis of submissions during the hybrid phase, we found that 20% of IDs manually entered failed validation checks.

With the paper-based model, there were fewer errors but these errors could not be resolved quickly because of the need to check up the consistency of data in each paper form – and sometimes this process of quality checks on the IDs could take months to complete. In the paperless (fully mobile) system, these errors were eliminated as IDs were looked up on the fly (in dropdown buttons) at the point of data collection, and of course, submissions were instantaneous, unlike the paper-based system where the submission of filled forms could take days to months. A data manager remarked that: “After switching from the paper-based system to the mobile-based system, we no longer spend months tracing errors in the data capture and entry process. We are able to start analysis immediately after data collection rounds.”

4. Discussion

The scope of the research has been limited by implementation in only one district (Akpabuyo) within the entire State. However, it has been acknowledged as a model for high quality data collection not only by the Cross River State HMIS, but also by the National HMIS. Thus, its contributions are usable and generalizable outside the geographical context in which this work was done. Particularly, lessons learned from our research include mechanisms by which mHealth can reduce the complexity of community data collection for the HMIS.

4.1. Lessons learned from implementation – Mechanisms for mHealth efficacy

Below are important mechanisms for mHealth efficacy that have been identified from the case discussed in this paper where a mobile data collection system largely replaced a paper-based system, improving efficiency and effectiveness in the data collection process. Overall, the mechanisms have been sorted into four aspects:

4.1.1. Savings in organizational resources

Firstly, there were cost savings from the reduced use of paper: The implementation was able to save on the significant costs involved in printing, copying, distributing, transporting and storing of paper forms. (We are exploring approaches in quantifying these cost savings to strengthen the evidence for these cost reductions.)

Secondly, we found that there was a reduction in workforce requirement: less paper-based entry meant a reduction in the number of data entry clerks required and the number of workers involved in the paper supply chain (including printers and driver person-hours). Thirdly, and related to the foregoing, the reduction in the workforce requirement led to more efficient re-organization of the data collection work: data entry workers that were rendered redundant by the mobile data collection were repositioned as data

collectors and data quality supervisors. In this way, mHealth provided an occasion to restructure the organization, streamlining it for more efficiency.

4.1.2. Data quality – Improved Organizational Information Quality for the MoH

The information from the community-level HMIS is an asset to the Ministry of Health, and the quality of the information determines its value and usability. The mobile solution helped in significantly improving the information quality by ensuring consistency, completeness and timeliness of data collection and submission. Moreover, immediate electronic-based capture at the point of data collection (during the interview) in the village eliminated a significant number of errors that are usually attributed to multiple levels/points of data entry and re-entry (such as manually copying out or summarizing data at the district level). In other words, by automating the process starting from the collection in the field, importing, and linking these data with the HMIS (DHIS2), manual transfer errors as well as conceptual misunderstandings and delays in vetting and analyzing data were significantly reduced.

4.1.3. Organizational efficiency

Traditionally, in the paper-based system, there are many steps involved in getting paper forms: from printing the paper forms, to distributing it down to the districts and onto the villages for use. These steps also involve the supervision mechanisms. For example, in the paper-based system, if there were errors, it could need revisits (travel) from the state to the communities. However, with the mobile system, it was more efficient to call the field workers on the field, and to point them to certain mobile forms that needed follow-up. In addition, the agility and speed with which forms are designed and deployed to (i.e. downloaded on the mobile while in) the field improved the efficiency of the data collection workflow. Furthermore, data communication between districts and the state via interoperability and linkage with state and national systems led to improvements in the availability of complete, accurate and timely data for the national HMIS, and was a key efficiency gain. In addition, we were able to leverage the internet to improve accessibility to real-time data hosted on a centralized web-based server. As one of the health managers at the state said, “This project has demonstrated to us that we can rethink how we work in the entire state ministry. We can cut costs, decrease the error rates and be much more efficient in how we collect and transmit data, not just in this district but in the entire state. And I like it that it is web-based, as I can check here in my office and know what is happening across the villages.”

4.1.4. Increased opportunities for the HMIS

The vast majority of HMIS systems enter in aggregate level data because it has been operationally inefficient to collect, store and process vast amounts of individual level data using paper-based systems. However, with electronic data capture at the point of contact, using low-cost mobile solutions, we

found it could be more cost efficient to collect individual level data. Furthermore, because this data collection and storage involves longitudinal individual data, community workers, using the mobile device, can seamlessly retrieve historical data for individuals on follow-up visits. Such seamless retrieval would have otherwise been impossible, or at best difficult, in the paper based system as it would have required checking through piles and shelves of paper for even the simplest data point. In addition, the longitudinal information collected opens up opportunities for targeted sampling and informed (evidence-based) cohort definition for studies (e.g. targeting subpopulations of young children, pregnant women, etc.). This can allow data collection for population-level public health research be more focused, efficient, and allow for statistical inference with confidence intervals. Additionally, we conjecture that further possibilities such as GPS navigation on the phone as well as streamlining follow-up visits for individuals can significantly increase the efficiency of data collection.

4.2. Next Steps and Areas for Further Research

There has been a significant improvement in mobile data collection, and based on the received feedback, the participants have been happy with the progress, though there were a number of challenges faced. We believe these challenges, nevertheless, are surmountable, mostly by specific workarounds and emerging solutions, and, are the focus of ongoing and future work, and represent areas of recommendations for further efforts by mHealth researchers. The challenges have been categorized into technical and organizational.

4.2.1. Technical Challenges

Data can readily be lost if the mobile device is lost (or stolen) before the data is successfully transferred. And poor network coverage can delay data transfer. However, mobile penetration continues to improve, thus increasing possibilities with synchronizing collected data more often (with the server) from within different locations in villages. Another issue is that of mobile device downtime due to irregular power supply, which occasionally hinders data collection. However, there are emerging approaches to powering mobile devices extraneous to the power grid, e.g. portable solar systems and portable recharging devices. In addition, the newer models of tablet devices, which run for longer than most mobile phones, provide a viable and cost-efficient option – and they can equally be powered without reliance on the traditional power grid.

During our research, we found that there was the need for an information system to assist field managers and HMIS staff in fieldwork management. This could be in the form of a dashboard that allows for managing field operations e.g. dashboards for monitoring form submissions. There could also be an automated messaging system that tracks and forwards important instructions back and forth field workers involved in the data collection.

4.3. Organizational Challenges

Subtle resistance to change was encountered as the mobile system introduced some redundancies in the function of the data entry staff. The work of data entry staff had to be reorganized i.e. some intermediary roles were removed and workers relocated to the field as data collectors and supervisors.

In addition, as has been previously reported [25], there was a policy gap in HMIS implementation – there was insufficient guidance from the existing HMIS policy on pertinent aspects of data collection e.g. data security & privacy. However, there is emerging work in this area – the mHealth alliance, working with law firms in Nigeria and with the MoH are working towards developing a context-sensitive policy document around this. Insufficient understanding and weak local organizational capacity at the MoH was a challenge. In the course of the work, we have carried out training sessions and made recommendations for more capacity building at the MoH. We believe this should be a major focus for future work.

Beyond meeting these challenges, next steps would involve continuing field testing of the mobile application on tablets, and improving usability design. In addition, we hope to explore scaling, build synergies and examine more possibilities that mobile technology can offer. Concerning synergies, there are other mHealth projects in Nigeria using mobile technology to improve HMIS data collection. For instance, some authors [12, 25] have described the use of SMS to improve HMIS data transfers by community health workers from health facilities in Nigeria. It would be interesting to explore synergies with similar mHealth projects to allow for even more integration and scalability.

5. Conclusion

This paper has pointed to challenges with the community-based HMIS-related data collection and described a successful mobile technology-based approach to meeting them. Particularly, it highlighted the mechanisms and strategies through which mobile technology can facilitate improvements in HMIS data collection. Overall, evidence from the research suggests that mHealth efficacy translates to savings in organizational resources; increases in information quality and organizational efficiency; and the opening up new possibilities for HMIS data collection. While the gains also come with challenges, these challenges seem to be surmountable and are important areas for future research.

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*Work in Progress:
Asangansi & Shaguy*

*Complex Dynamics in the Socio-Technical Infrastructure:
The Case of the Nigerian Health Management Information System*

COMPLEX DYNAMICS IN THE SOCIO-TECHNICAL INFRASTRUCTURE: THE CASE OF THE NIGERIAN HEALTH MANAGEMENT INFORMATION SYSTEM

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Abstract: This paper discusses the results of an ongoing research which contributes to the current discourse of how the application of information and communications technologies can foster socio-economic development. Specifically, it discusses the socio-technical dynamics associated with the implementation of a computer-based health management information system as well as factors that contributed to a successful implementation. The Nigerian health system continues to negotiate a dramatic turn with the implementation of a computer-based public health information system, based on the principles of primary health care. Important findings in this study have included: the realization of the role of political buy-in as crucial for successful implementation; the HMIS is an installed base in constant evolution; democratization and political decentralization contribute to the success of the primary health care-based information; and the implementation of a free and open-source solution reduces total cost of ownership.

Keywords: Nigeria, health management information system, socio-technical, primary health care, dynamics, complexity, DHIS.

COMPLEX DYNAMICS IN THE SOCIO-TECHNICAL INFRASTRUCTURE: THE CASE OF THE NIGERIAN HEALTH MANAGEMENT INFORMATION SYSTEM

INTRODUCTION

Health is an issue of central concern to all countries and societies as it is a crucial cornerstone for socio-economic progress. The fundamental struggle to provide good health care to all in the society is epitomized by the Alma Ata declaration of 1978 which states that health “is a fundamental human right” and its attainment is a “most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector”. This code, to which Nigeria is signatory, prescribes that “primary health care is the key” and that “governments have the responsibility” [1]. Unfortunately, this goal of universal primary health care, as stated in the Alma Ata declaration has not been achieved. One of the impediments to this is thought to be the lack of an information system to guide decision making and planning [2]. This is an issue that has continued to plague most developing countries [ibid] including Nigeria. But this is gradually changing. Currently, the Nigerian health system negotiates a dramatic turn, with the implementation of a computer-based public health system that is based on a district health information system embedded with data handling best practices. This district health management information system is based on a free and open source health information system developed by an international team, configured and maintained by a local team with considerable expertise. But, how did this implementation come to happen? This paper discusses the dynamics involved in the establishment of the health information system and how this is tightly linked with policy and socio-political factors. The lesson to be learnt herein is that a number of external factors influence the dynamics of the health information system, a major one being health policy – the socio-organizational installed base. The paper also mentions important areas that health management information system policy needs to address.

1. BACKGROUND

1.1. Nigeria - The Context

With a population of over 148 million people [3], Nigeria is a heavily populated country that accounts for about half of West Africa’s population [4]. However, 71% of the population lives below the international poverty line [5] and the average per capita income is US\$930 (ranking 161st in the world)[6]. In April 2007, Nigeria held its third consecutive national elections, further consolidating the military-to-democratic transition that began in 1999. Health indices have remained poor and healthcare provision remains a major concern for the democratic government and its partners. The poor condition of health and health care in Nigeria is one of the factors responsible for an average life expectancy of only 47 years [7]. The country is committed to the long-term United Nations (UN)–sponsored Millennium Development Goals (MDGs) [8]. Under the program, which covers the years from 2000 to 2015, Nigeria is committed to achieving a wide range of ambitious objectives involving poverty reduction, education, gender equality, health, the environment, and international development cooperation. In an update released in 2004, the UN found that Nigeria was making progress toward achieving several goals but was far from achieving others. Specifically, Nigeria had advanced efforts to provide universal primary education, protect the

environment, and develop a global development partnership. However, the country lagged behind on the goals of eliminating extreme poverty and hunger, reducing child and maternal mortality, and combating diseases such as human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) and malaria. Thus, the "development of human capital through provision of health services" represents a central thrust of the present democratic government's 7-point agenda [9].

1.2. Policy and Implementation

Nigeria inherited a weak colonial health system from England at independence in 1960 [10]. Subsequently, it went through three unsuccessful National Development Plans and did not have a comprehensive strategy for the health care system [10]. It was only until the Alma Ata declaration in 1978 that the country was primed for health reform. Nigeria made official commitment to the Alma Ata declaration which called for a primary (grassroots) healthcare approach in line with providing care for all citizens. The country worked towards a National Health Policy which was only realized ten years later. Within these ten years, there existed 4 successive national governments - three of them being military governments enthroned by coups d'états. As expected, the National Health Policy that was promulgated had primary health care as the central thrust. The policy provided, for the first time, the establishment of a coordinated and robust country-wide Health Management Information System (HMIS).

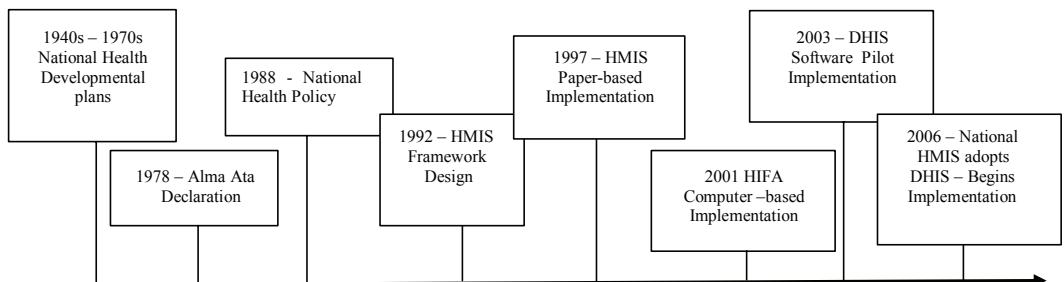


Figure 1. Timeline showing key events in the development of the Nigerian Health Management Information System

In response to this legal platform, the HMIS framework was articulated in 1992. A work plan was devised (in 1996) and implementation commenced (in 1997) in a number of states, with support from donors (World Bank and the UK Department for International Department) [11]. In 2000, when donor support fizzled out, the project failed. However, with a successful transition from military to democratic rule (in 1999), the ban on funding from the United States Government was lifted later in 2000.

HMIS funding came in through VISION, a collaboration between the US-based EngenderHealth, Johns Hopkins University and other partners [12]. Working with the Federal Ministry of Health, the VISION program implemented the country's first computer-based national health information system in 2001 with pilots at Bauchi, Oyo and Enugu states. This system, Health Information For Action (HIFA), was proprietary (not open-source) and was DOS-based. It worked with the EpiInfo 6 and EpiMap 2 software applications [13] and was network-aware [12]. Its implementation represented the first introduction of computer technology for managing the HMIS. However, the implementation encountered a number of challenges that included the use of a dataset that was too large, poor supervision at the facility

level, poor interconnectivity and multiple parallel systems [12]. The project ended after the scheduled time and HMIS activities were again underfunded for a few years.

In 2003, as the VISION pilot projects were ending, the United Kingdom-sponsored Partnership for Transforming Health Systems (PATHS) project started. This program, gaining from lessons of the past and utilizing principles that had been learnt from similar HMIS work in South Africa and other countries in the HISP network introduced the minimum dataset approach. A free and open source software, the District Health Information System (DHIS) [14] was also introduced. During this period, connectivity improved in Nigeria and local capacity to deploy and maintain these systems was developed. The minimum dataset approach and the DHIS implementation were successful and continued beyond the end of the PATHS project in June 2008. In 2006, during the DHIS implementation by six states supported by the PATHS project, based on an open tender process, the DHIS was adopted by the Federal Ministry of Health as national standard [15] for the HMIS and country-wide implementation was planned. The system is being scaled up, in phases, to all states.

2. METHODOLOGY

This study adopts a qualitative case study approach. This is in order to aptly describe the context, the observed events, actors and processes. Data for this work have been collected through direct and participant observation as well as relevant documents the authors had access to during fieldwork. Thus, this analysis is based on both primary and secondary data. Because of secondary elements in the empirical data, it is difficult to draw clear-cut distinctions between phases of the action research cycle. This work is primarily aimed at laying the foundation for the analysis of ongoing and planned study. The underlying participatory action research framework in which this work was done is a long-term project called the Health Information Systems Programme (HISP) [16, 17]. The HISP project was initiated by universities in Cape Town and Oslo in 1995, and is now present in a number of developing countries. Within each country (e.g. Nigeria) the projects are comprised of various actors in the health administration (community, sub-district, district, provincial, and national), universities, non-governmental organizations (NGOs), and funding providers. At the global level, with the Norwegian and South African nodes as the major coordinating bodies, HISP has over the last decade been engaged in the development and implementation of health information systems with emphasis on facilitating sharing of software and best-practices. In the specific case of Nigeria which is the focus of this paper, the HISP project played a major role in supporting the development of the new HMIS. The authors, working within HISP, have been involved in the development and implementation process and performed numerous field trips to many states in Nigeria, and worked in close collaboration with the various stakeholders at national, state, district and primary care centre levels.

On the whole, using action research as the underlying framework allows one to take an active role in understanding an information system while being able to do lots of self-reflective inquiry. Action Research is a disciplined process of inquiry conducted by and for those taking the action. Such participatory approach assists the researcher-participant in improving and refining his/her actions [18].

3. FINDINGS

The Nigerian health management information system (HMIS) is structured in accordance with the national health policy and can be discussed as being made up of a number of components. These components include the people working in the system, the tools they use, the data

involved and the processes used to handle these data - all of these occur at the different levels of hierarchy as stipulated by the national health policy which follows the civil service system.

3.1. People

HMIS human resource is structured along the lines of the tiers of government. At the local level, the HMIS component is housed in the local monitoring and evaluation department where the local government (district) information officer works. Health staff that report to this level include community health extension workers, community health officers, medical officers of health, community nurses and a host of trained and untrained community' workers. At the state and federal levels, the HMIS unit is housed in the planning, research and statistics department. At these levels, one finds more skilled information workers – including epidemiologists and public health staff. It is important to note that the HMIS unit and its enveloping health service structure is tightly coupled and embedded within the political structure. This is because they report to elected politicians who in fact make the final decisions on HMIS financing and health policy as well as decisions bordering on recruitment and appointment of staff. This has immense significance for the allocation of resources for information systems activities - decisions tend to be made by politicians who are influenced by financial considerations, special interests and external pressures, rather than evidence coming from service delivery or surveys [15]. It has been said that “the health care sector in developing countries is intrinsically political. It circles around the inherent scarcity of resources and involves a number of actors with different agendas such as donor agencies, health activists, nongovernmental organizations, vendors, consultants, and politicians” [17]. This aptly describes the Nigerian case.

In summary, the actors exist in a complex mix of cooperative and competitive behavior. These tensions when extended to the entire health system give a complex mix of competitive and cooperative behavior between actors which include health workers, local government monitoring and evaluation (M&E) officers, primary health care (PHC) department officers, local decision makers, the local traditional institutions, state ministry of health decision makers, government ministries of health at federal and state government levels, donors, international and local non-governmental organizations (NGOs), software vendors and consultants. The table below outlines some of the important human actors in the system.

Table 1. Human actors in the Nigerian HMIS

Level	Human Actors
Federal	Epidemiologists, information officers, elected officers, health administrators, international partners, local NGOs, consultants, researchers, program officers
State	Epidemiologists, information officers, elected officers, health administrators, partners, local NGOs, consultants, researchers
Local (district)	Local Monitoring and evaluation (M&E) officers, district information officers, PHC Department Officers, District head (traditional ruler), Local government chairman (elected district

	government), vertical program officers
Facility	Patients, health workers, health records officers, the community

3.2. Data

The National HMIS is built in the context of the national health strategy, which currently focuses on the MDGs. That is, focus is on data that are important for achieving primary health care goals and targets and other goals based on the MDGs. This has motivated the use of a small essential dataset in the HMIS with data elements that are clearly defined and standardized. This approach is the minimum dataset approach that has been successful in the HISP projects in South Africa [19, 20]. It is based on the use of only appropriate data elements at each level of reporting – appropriateness being defined by the need for information to inform and drive action at that level. We found this approach to be successful and contributory to the harmonization of the data collection forms used at the levels of reporting (i.e. at facility, district, state and federal levels).

3.3. Processes

A process is a series of actions that are performed in order to achieve a particular result. Within the HMIS space, the processes include those that are taken in order to produce information for decision-making and action. These processes guide the day-to-day running of the Nigerian HMIS system.

The processes include data collection, processing, analysis, presentation, interpretation, use and feedback. Collection involves the gathering of data from relevant sources. These sources include routine data reports from health facilities and surveys in a wide variety of settings. Processing involves collation, the aggregation of data for processing and onward flow; and data quality checking. Quality checking normally involves ensuring that data is correct, complete and consistent.

Analysis involves the calculation of rates, ratios and proportions and other operations on the data to make it useful for action. It normally involves the generation of key performance indicators useful for monitoring and evaluating progress. The data can then be presented for discussion using different kinds of illustrations, graphs and charts. The use of the information for action is important for the information handling process. Feedback is an ongoing process that works in the opposite direction, with the processes feeding back to the step that led to them.

3.4. Tools

Here we found and used the paper-based system, and the computer-based system:

3.4.1. The Paper-Based System

This system is based on paper forms for collection of data at different levels. Health information handling has traditionally been practiced in Nigeria the ‘paper way’ and paper-

based records are still by far the dominant record keeping system. However, the use of data stored in this form has been a persistent problem as it is difficult to analyze to derive the information needed to drive the decision making and governance process.

However, the paper forms are well integrated into the workflow and do not need any electrical power to run, no antivirus and no special operating systems, as opposed to the computer-based system. However, there are a number of perceived problems with this system, as was revealed in surveys of health workers in Nigeria [21]. These problems include poor access to the stored information; data in paper forms are not easily presentable; take a lot of time to extract; are not durable; require too much space for storage and are generally ineffective. These are major problems the computer-based system aims to solve.

3.4.2. The Computer-Based System

The DHIS is a software application developed for public health management information systems by the international HISP group [14]. It has been continuously adapted for field conditions by participatory effort between health care and software professionals in several developing countries since 1994. This has resulted in the DHIS software addressing vital issues such as user friendliness, data accuracy, and the design and use of indicators based on local need. This software allows data to be transmitted to other users, both horizontally or vertically up the hierarchy.

Keeping in mind the dynamic nature of health care management, the software was designed to be extremely flexible to address changing needs at the field level over time and space. Besides serving as a tool for gathering, transmitting and storing data, the DHIS is designed especially to address data analysis and hence the use of health information. It supports functions of accurate and valid data collection, aggregation, storing, sharing, transmission, analysis, reporting, display and use of health data at and between every level of a district health system from sub centre to district and at the state level. It allows drilling down or aggregation of data at any and every level of the health system such as PHC, district, state and national levels. Essentially, it addresses the need for a national health information system.

The DHIS is constantly configured to reflect the paper-based HMIS that it interfaces with, ensuring that users of computer-based system who are familiar with the paper-based system find it easy to combine both as necessary. This is what forms the paper-computer gateway.

Since the pilot of the DHIS in Benue State, a massive scale up has happened – the neighboring Enugu state adopted it, Jigawa followed and later Ekiti, Kano and Kaduna states joined. In October 2006, the DHIS was adopted for the “new NHMIS” under the health systems development project. But today, the scaling up of the system has become a “pre-requisite and not just a luxury”. This is because, in order to make sense of data from facilities and services in a region, province, or country, more data is needed to provide a complete and more useful analysis [17]. As more data are collected and made available, more data are needed to significantly test hypotheses and calculate key performance indicators, allowing for informed decision making.

4. DISCUSSION

The Nigerian health management information system has evolved in the context of the health system and its socio-political environment. It has been affected by external influences such as donor support and technological events such as global commons-based open-source software production within HISP. Some of these are illustrated in figure 2 below.

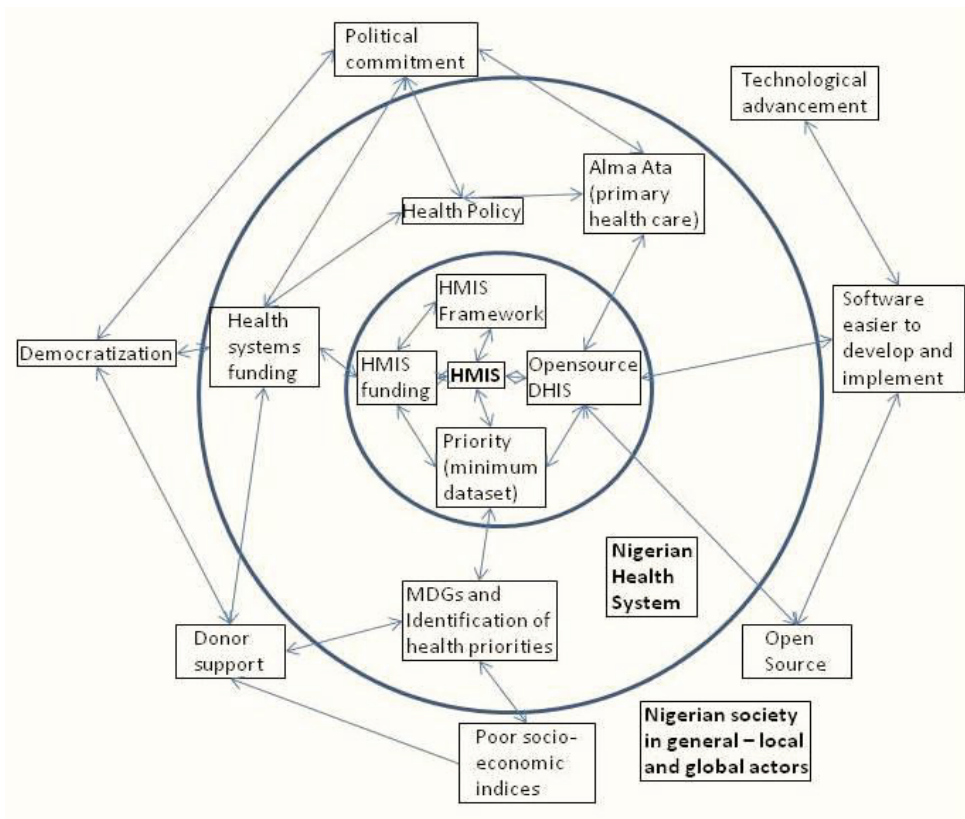


Figure 2 is a diagram illustrating some of the numerous influences that have shaped the health management information system (HMIS) in Nigeria. The inner circle contains factors very specific to the HMIS, the outer contains those specific to the health system. Outside the outer circle are a few important 'external' factors discussed also in this paper. It is important to note that this last group of socio-technical factors is unbounded – to show that it is a shared open heterogeneous system in the manner of an information infrastructure as described by Hanseth [22].

There are key lessons to be learnt from this case:

1. The system is continuously evolving:

The health system with its embedded information system is an *installed base* consisting of an extremely heterogeneous socio-political setting with interdependent and interconnected actors and actions. According to information infrastructure (II) theory, the installed based "implies that infrastructures are considered as always already existing, they are never developed from scratch". It is composed of tightly interdependent and interconnected collections of socio-technical components [23, 24]. Essentially, it develops gradually over time. It does this through a process involving gradual expansion, improvement and replacement of its parts. Really, no single actor is in control and the infrastructure has not

been built from scratch within one project. In essence, the Nigerian health information system and its enveloping health system have continued to evolve with the socio-political system. The HMIS has not been built from scratch but has used components from health policy and the primary health care system. The HMIS has a large number of actors including people, tools, data and processes which have all evolved through time as evidenced by the change in policy as shown in figure 1. This installed base, as Edwards et al [25] have put it, consists of all the organization processes, technical infrastructure and social norms that collectively provide for the smooth operation of the system. A major component of this installed base is the political practices and governmental bureaucracy.

2. Political buy-in is crucial for success:

Political buy-in was instrumental in establishing the system. Most policy makers began to see the need for dynamic reform based on evidence. This political buy-in, in such a top-down system as is obtained in Nigeria's governmental bureaucracy, helped to push health policy reform and the attendant HMIS development. The role of Alma Ata in shaping health policy has been described in this paper, as well as the government's commitment to its principles and the prioritization of primary health care. This allowed more funding to come into primary health care information systems development and implementation as the government was supportive. Some of this funding has come from donor support, which has increased since the ban on funding was raised when Nigeria moved from a military dictatorship to a democratic system.

3. Democratization and political decentralization contributed to the success of the primary health care-based information system implementation:

A democratic system means that more people become involved in decision making and communities become empowered. If the health care system and the polity are thus decentralized, then the information system (HMIS) that drives these systems needs a concomitant decentralization to the primary levels. No wonder it has been recommended that a health information systems should be designed to work at the lowest level to ensure decentralized management and coordination of the health services [26].

However, it has been argued by Soriyan et al that for any information system based on primary (decentralized) health care to be acceptable and appropriate, it must be developed based on right requirements [27]. This is applicable to the development of the district health information system (DHIS) software and its use in the setting of the Nigerian national HMIS. It started as a practical project to solve a real need and the requirements were in keeping with the primary care approach and evolved and grew with it.

4. The implementation of an open-source solution reduces total cost of ownership

By virtue of the nature of the development of the DHIS, being based on a free and open-source philosophy and a distributed international network of learning, the ownership of the system is made cheaper on the long term. This in itself drives technological innovation and advancement and can allow for self-sufficiency by local teams using it.

5. CONCLUSION

The socio-political environment, health policy and HMIS implementation are tightly interconnected. Substantive progress has been made in strengthening the HMIS; health policy

needs to respond by harmonizing multiple efforts by funders – that is, building cohesive systems, and thus, limiting fragmentation and *vertical-ization*, fashioned by administrative, economic or donor pressures. For a robust HMIS, a robust policy and framework needs to be present. It is important to build health policies that allow the HMIS to achieve the overarching goals of the socio-political system, with an understanding that the decentralizing socio-political structure of the country and global influences play important roles.

With continuing investments by donors in the country's health system, there is pressure to show genuine progress towards achieving the millennium development goals. Health care departments and programs are obligated to show progress as pre-requisites for extended funding support. The resource proliferation will present opportunities and challenges in good measure. Capacity will continue to be strengthened, infrastructure will improve, integration challenges may arise and the socio-economic dynamics will continue to play a role in the system. A continuing challenge is to roll-out the system nationally by strengthening information management through improving access to, and use of reliable information for the management of health programs and services at all levels.

According to Orobaton, a manager with the WHO-hosted partnership, Health Metrics Network, a mistake that was made in the past was to focus on the mainstream health sector at the expense of other sectors; “future implementation of primary health care in Nigeria will have to address the considerably more decentralized political system, a much more dominant private sector, increasing demand for a reliable health information system and expanded roles for non-health sectors” [28]. A successful system would be one based on practical, scientifically sound, socio-politically acceptable and economically sustainable methods and technologies that make information on health-related activities accessible at the different levels and/or aspects of care with the necessary level of relevance at every stage of the system's development.

From the foregoing, an important consideration for further research would include exploring how actors can be aligned towards the goal of tilting the socio-political equation in favor of health policy that would permit more decentralized HMIS structures as well as a culture of information use. The question of how sustainable infrastructures can be best built is also an important one.

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