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STRATEGIES FOR DEVELOPMENT AND INTEGRATION OF HEALTH INFORMATION SYSTEMS: COPING WITH HISTORICITY AND HETEROGENEITY

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Strategies for development and integration of health information systems: coping with historicity and heterogeneity

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Abstract:

Health is crucial for development, and well-working health information systems are required for sound decision making and effective use of resources. However, establishing working information systems in developing countries is truly a challenge. Moreover, strategies for the development and integration of large and growing collections of information systems escape simplistic recipes. This is a pressing practical problem globally, as well as analytically under-researched within the IS field. We aim to contribute to the understanding and development of such strategies by underscoring two core dilemmas: (i) the conservative influence of historically accumulated and institutionalized practices, technologies and perceptions (dubbed the 'historicity' of information systems) and (ii) the lacking integration and increasing fragmentation across the collection of information systems (dubbed the 'heterogeneity' of information systems). The empirical underpinning for our analysis is an action research project, the Health Information Systems Program (HISP), which aims at improving existing sub-optimal health information systems in developing countries. HISP provides a particularly poignant illustration of the challenges related to historicity and heterogeneity of information systems as these are implied in the politico-historical context. Our empirical material is a cross-national comparative analysis of the current reporting systems for administrative health data in Mozambique, Tanzania and in the state of Andhra Pradesh in India. Several problems are associated with the existing systems and the need to change or replace them is recognized. For example, due to the donor- and aid-dependent economies of most developing countries, there are often other specialized health care programs e.g. targeted towards specific diseases like malaria, tuberculosis and HIV/AIDS. These programs usually have their own reporting systems, and the result emerging over time is a disintegrated and heterogeneous collection of systems. The challenges associated with attempting to change such large-scale, heterogeneous and fragmented systems involve complex dilemmas. As the current information systems are embedded and institutionalized nationwide, a realistic strategy need to take a phased approach whereby present systems are gradually integrated into the environment. In the case of donor-supported and -managed program, the national health authorities may not even have the required power to intervene. Thus the existing reality cannot be ignored or done away with, whether it be the information systems, the institutions or the work practices; they constitute the point of departure. Analytically, we draw on recent socio-technical conceptualizations of large, integrated systems - so-called information infrastructures - especially through recent elaborations in the theoretical foundation in actor-network theory (ANT). The development strategy we suggest emphasizes an evolutionary, 'cultivating' approach while at the same time accepting that there will be a certain level of non-integration (often perceived of as 'mess') as chronic.

Keywords: strategies for development of information systems, legacy systems, cultivation, fragmentation, actor-network theory, action research.

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1. Introduction

Research reports from implementation processes of information systems in developing countries are hardly uplifting reading. When “implementation” is recognized to extend well beyond the merely technical realization of an information system, there is a substantial body of literature describing the economical, social, political and technical problems that tend to undermine these efforts (See Walsham 2001; Avgerou 2002; Heeks 2002). Key reasons include the scarcity of resources and poor infrastructures (Mosse and Sahay 2003), embedded political controversies (Adam and Myers 2003; Puri 2003) and inability to sustain the use and spread of the information system over time (Braa, Monteiro and Sahay 2004).

These general concerns for information systems in developing countries are intensified when it comes to the specific domain of health care. Providing improved access to the health care sector is a highly prioritized aim of any (developing) country. There is also growing acceptance for the potential role of information systems in achieving this. Furthermore, as a consequence of recent critiques of traditional models of development (Sen 2000), improved health care is viewed not only as an *indicator* of development; it is a *driver* of development with rich spill-over effect. In the words of the 1993 World Development Report: “Because good health increases the economic productivity of individuals and the economic growth rate of countries, investing in health is one means of accelerating development. More important, good health is a goal in itself” (World Bank 1993). Strengthening health care provision through improving the information systems in developing countries is accordingly intrinsically linked with promoting development in general. Yet, the very notion of ‘development’ gets problematized as a direct result of the critiques of post-colonial reasoning. This critique directs attention to the centeredness (read Western bias) of narratives, language and rhetoric – including ‘development’ – by “a critical reflection on knowledge production from both the interior borders (imperial conflicts, hegemonic languages, directionality of translations, etc.) and its exterior borders (imperial conflicts with cultures being colonized, as well as the subsequent stages of independence or decolonization)” (Mignolo 2000:11, see also Spivak 1999).

The aim of this paper is to crystallize out strategies for (lacking a better phrase) the development and integration of information systems in developing countries through a cross-national comparative analysis of an ongoing effort within health care in three developing countries. The health care sector provide a poignant instantiation of what we argue are two core challenges around which generalized strategies need to be constructed. Firstly, there is a *historicity* stemming from the manner sediments of earlier solutions, entrenched routines, prevailing perceptions and social institutions constitute and solidify existing practices. For example, in their study of GIS, Walsham and Sahay (1999) illustrates how the colonial heritage of the British rule is reproduced in present practices of Indian central bureaucracy. Legacy systems are another example of installed base, and in developing countries they are typically old, poorly maintained, commanding scarce resources, and the vendors or developers, often expatriate aid workers, are long gone. The historical-political ‘installed base’, subsuming legacy information systems, need to be addressed drawing on evolutionary, small-step, cultivation strategies.

Secondly, there is an intrinsic *heterogeneity* in both technical and institutional terms. In most developing countries several donor agencies are present. For instance, Mozambique has been an attractive target for aid, and the health care sector is dominated by a large collection of donor agencies (with external aid constituting an estimated 75% of the overall health budget) in addition to semi-autonomous governmental and international agencies. These agencies typically focus on specific, more or less confined areas through targeted, so-called ‘vertical’ health programs each with their own associated information system. This gives rise to fragmentation on a technical level, evident in the plethora of non-integrated information systems. The resulting political economy entail that no one agency, including the national health authorities, is in ‘control’ in any strict sense. This indicates that development strategies for information systems need to incorporate elements of improvisation (Orlikowski 1996; Ciborra 1997), in addition to, we argue, recognizing that a certain level of non-integration is inherent (Law and Singleton 2005).

In sum, then, we seek to extract generalizable strategies applicable to the development and integration of information systems that embed the historicity and heterogeneity of

this context. Empirically, we draw on an ongoing research project established in 1994, called Health Information System Program (HISP, see www.hisp.org). HISP is, in varying configurations and stages of implementation, currently present in 9 developing countries. We compare and contrast three of the participating countries (Mozambique, Tanzania and India) to make explicit the contingent or situated nature of the strategies we propose.

The next section of the paper elaborates our conceptual framework. Through an account of our experiences with information systems in developing countries, we briefly review the manner in which issues of legacy systems and non-integration have traditionally been conceptualized and approached as a predominantly technical challenge. Moreover, we illustrate how dominant approaches to the issue of integration of information systems aim for complete or total integration, doing away with all fragmentation. We also explain how elements of recent socio-technical conceptualizations of large, integrated systems – called information infrastructures – provide a fruitful, alternative perspective. Section 3 outlines our research approach. The case narratives from the three countries are presented in section 4. The analysis in section 5 is constructed around the two themes of historicity and heterogeneity of information systems. The concluding remarks in section 6 crystallize our suggested strategy and offer some reflections on its generalizability.

2. Conceptualizing historicity and heterogeneity in IS

2.1 IS implementation process in developing countries

Implementation of information systems in developing countries is usually characterized as problematic, and failure stories abound (Heeks 2002). Many bottlenecks in the development, implementation and use of effective IS have been identified, ranging from physical conditions, e.g. unreliable power supplies or telephone lines that affect the operation of technology, to the lack of economic resources and techno-scientific capabilities to support ongoing usage and maintenance of the technology, through to issues of technology management and utilization (Avgerou 2000). A substantial literature base describes economical, social, political and technical problems that undermine efforts of the implementation and use of ICTs (Walsham 2001; Avgerou 2002). In the domain of

health care these general concerns are intensified. Providing improved access to the health care sector is a highly prioritized aim of any (developing) country.

A well-working health care information system is a necessary part of any nation's effort to maintain and improve the health of its citizen's, and inadequate information support is viewed as the major obstacle for to efficient management of the health sector (Lippeveld et al. 2000: p.1). Further, health systems are often poorly designed, in a top-down manner and without participation of the health workers. Developing countries, particularly in Sub Saharan Africa are reported to have high rates of pandemic diseases such as HIV/AIDS, malaria, and tuberculosis that have significantly raised costs on human and social capital as well as significant drain on already constrained resources. These obstacles severely jeopardize the health and utilization of health care for their populations especially the disadvantaged group; the poor, women and children. Consequently, developing countries, have been continuously challenged to improve their health delivery system to upgrade the health status of their people through the use of IT to plan, monitor and evaluate health services (Braa and Hedberg, 2002) as well as communicate more effectively within and across organizational hierarchies so as to promptly deal with such epidemics

Unfortunately, the health information systems that operate in most developing countries demand massive data collection and reporting, but there is with none or very limited use of the information. The systems are designed according to the data-led approach where massive data is collected but with limited use, rather than the action-led approach where the focus is on information that supports management decisions and emphasis on data collectors as the main information users (WHO, 1994; Lippeveld et al., 1997). The data handling is carried out to reflect the need of the higher level bureaucracy rather than information needs for local actions (Sandiford et al. 1992). A further problem is that health information systems do not become part of organizational routines because of lack of ownership and insufficient support and capability of health workers. This often happens as a result of its inappropriate design approach that excludes key actors in the process (Korpela et al. 1998). The inappropriate design approach results in inflexible

information systems incapable of evolving along with dynamic institutional and technological changes (Bisbal et al. 1999).

The highly appraised – but ultimately overly idealized – ambitions of “health for all” (WHO 1978) turned out to be difficult to achieve, and alongside growing impatience and frustration with this, a number of more targeted programs have been put in place. These programs have concise and well-defined aims and are dubbed ‘vertical’ rather than the more generic ‘horizontal’ programs. Typical examples of these are the tuberculosis, vaccination, malaria, or HIV/AIDS programs. The reason why we emphasize these types of programs is that they embody technical solutions, established work routines and social institutions that are often poorly aligned with the national systems for reporting of (routine) health information. These programs often have an independent decision-making structure and an internal system for information reporting and resource distribution. The result is several parallel and overlapping information flows, a lack of integrated analysis, and a high burden of registration on health workers in the primary health care facilities. Some form of integration of these stand-alone programs is thus often in the topic of the health sector reforms, implying also an integration of the various information systems associated with them (Alvares 2004, Chilundo 2004).

However, improvement of existing systems and integration of the various parallel systems often presents challenges of a generic character. For example, a frequently mentioned obstacle for health information systems reform is related to legacy information systems, as the existing computerized systems are often typically old, non-changeable for various reasons, and do not support data sharing between different systems. Together with the fragmentation problem related to the existence of various data collection routines, tools, reporting systems and programs inside the same national health system this presents complex issues that warrant further examination through the IS literature.

2.2 Legacy systems and fragmented information systems

2.2.1 Strategies to cope with legacy information systems

The problems of non-evolving and technically outdated information systems have been recognized by the IS community for some time (Sommerville 2001). Old systems may be expensive to maintain, as they use obsolete hardware and non-supported representation formats, e.g. programming languages that few people know making hiring of skilled staff a challenge. Fault tracking may be tedious if documentation is missing or when system understanding is limited. For the same reasons the old information systems may also be difficult to extend or change in other ways. The systems are seldom interoperable with other systems due to lack of clean interfaces. However, legacy systems become a problem because they can not just be scrapped and forgotten. They may be deeply embedded in the organizations they support and be of critical business value. They may for example contain important business rules that are crucial to the organizations' processes, and are thus a major part of the company's knowledge base. The legacy systems' inertia or resistance to change is not only costly, but may also hinder organizational development. Legacy systems have shown a surprisingly high degree of survival. The year 2000-problem made legacy systems capture the attention of IS managers to a larger degree than before, and today e-commerce and back-end integration makes it a current issue. Much of the research literature in this area has a focus on developing methodologies and associated tools for migration, system analysis or reengineering. In general the strategies for handling legacy systems fall into three categories with varying degrees of radicalism (Bisbal 1999):

- *Wrapping* the old software components into new more accessible components. This means to create new interfaces to programs, applications and interfaces. This is seen as a partial and short-time solution, which may even make maintenance even more complicated. The technique of 'screen scraping' is one well known variety of wrapping, and providing web interfaces to access legacy data would be another.
- *Migrating* the system, i.e. moving it to a more flexible environment, e.g. to an object-oriented or component-based platform. The data and the functionality should be retained. Migration is thus a middle ground approach, aimed at causing as little as

possible disruption to the existing operational and business environment. There are several actual transition strategies: a) cut-and-run b) phased interoperability c) parallel operations.

- *Redevelopment* (and reengineering) means to rewrite the system from scratch, to make a new system. This often involves substantial amount of analysis of the old system to make sure it is correctly understood.

These three approaches share a heavy technical bias, in the sense that they fail to address organizational or social issues around legacy systems.

2.2.2 Strategies to cope with fragmentation

Organizational and technological changes may lead to a slowly accumulating portfolio of various disparate information systems within an organization. Integrating the subsidiaries of large multinational companies or mergers of companies with different information systems makes the issue highly relevant for the business oriented part of the IS community. In the context of aid receiving countries, a significant source of heterogeneity is the donor-driven semi-autonomous activities described earlier that may exist partly or wholly beside national structures. The ensuing fragmentation and sub-optimal use of scarce resources are taken to justify the need for tighter integration. With better integrated systems one would avoid redundant operations cut back on administrative overhead. The vision of tighter, or indeed, 'seamless' integration of the many health information systems, is pronounced also in efforts in Western health care. As argued in Grimson, Grimson and Hasselbring (2000:49):

"[S]hared care depends critically on the ability to share information easily between care providers. Indeed it is the present inability to share information across systems and between care organizations automatically, that represents one of the major impediments to progress toward shared care and cost containment".

The quest for integration, however, has been prolonged, or as Kumar and van Hillegersberg (2000:23) phrase it “integration has been the Holy Grail of MIS since the early days of computers in organizations”.

The approaches and technologies for integration vary widely and there is not one generally shared scheme of classification or relative ordering. For the purpose of this paper we will discuss the various solutions along a continuum from conservative to radical approaches, relating to the degree of intervention (see figure 1). In one end of the continuum, accepting ‘loose integration’, is the conservative approaches that aim at ‘living with’ fragmentation. One example of this would be to provide web-enabled (browser) access to various underlying data sources through a portal solution. In the other end of the continuum, pursuing ‘tight integration’, fragmentation is attempted eliminated, e.g. through replacing the various disparate systems with one comprehensive, fully integrated system. Implementing an Enterprise Resource Planning (ERP) system would be a typical example of one system that is expected to cover all functionality previously contained in multiple systems. In between are a variety of other forms of integration where standardization at a certain level is the basis for interoperability.

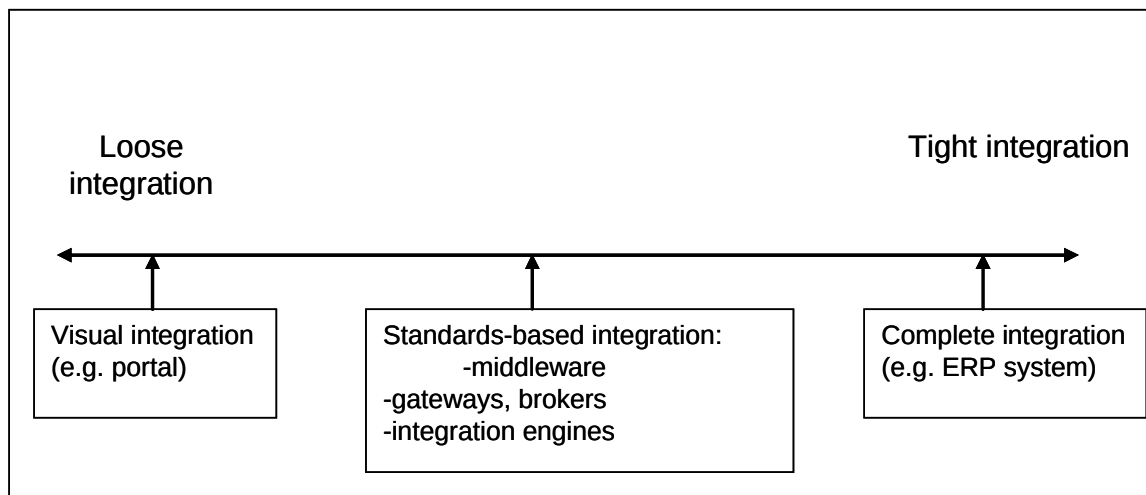


Figure 1 Conceptualizing a continuum of approaches to the integration of information systems

While the tight forms of integration requires the aligning of data formats, functionality, and business logics, looser forms of integration may specify standards that allow a certain heterogeneity ‘behind the stage’. This corresponds to imposing standardization on

different levels. Standards-based integration may again be envisioned along a continuum between ‘tight’ and ‘loose’ approaches, as the kind of standard may vary widely. Integration may be based on shared standards for structural elements, such as standards defining the underlying information models. Less ‘tight’ standards may be interoperability standards, e.g. defining an XML-based syntax that allows exchange of data structures between various systems. Middleware integration aims at the syntactic level and comprises e.g. CORBA (Common Object Request Broker Architecture), database gateways and transaction monitors. Gateways and brokers (which again may be generally standardized or based on ad hoc, proprietary interfacing) allow the continuous existence of multiple systems, each with their internal organization and logic. For example, most solutions for Enterprise Application Integration offer generic adapters for specific (ERP) systems.

Our critique of the legacy systems literature applies also here. With a few exceptions (cf. Webster 1995; Chilundo and Aanestad 2005), the challenges have predominantly been conceptualized as being purely technical in nature. As integration of information systems seems to be primarily a practitioners’ issue rather than an academic core topic in the IS field, there is but scattered critical and analytical literature on the organizational and political challenges associated with integration, e.g. when an organization integrates its systems with the subcontractors’ information systems, there is an element of exertion of power camouflaged in technology (Webster 1995). Hence, we argue that a critical and theoretical literature on integration needs to acknowledge the socio-technical nature of the phenomenon, i.e. how integration meshes also with organizational and political issues (Monteiro 2003). Furthermore, there is almost no problematization about the vision, viz. the goal of complete and ‘seamless’ integration. It is implicitly or explicitly assumed that full integration and true interoperability is desirable (Hasselbring 2000). This is highly problematic as growing empirical evidence as well as analytical insights questions the attainability of this.

To this end, we outline a body of research studying large-scale socio-technical ensembles as information infrastructure. Drawing on insights from actor-network theory (ANT), this

body of work underscores how integration also is a socio-technical process of negotiation, *and* a process that does not always succeed.

2.3 Lessons from an Information infrastructures perspective

In contrast to the relatively delineated, predictable, and manageable information system, an information infrastructure is open and evolving. An information infrastructure serves multiple users and use areas and is a shared resource for a community. In most definitions of information infrastructures the historical and pre-existing, the ‘installed base’, is allocated a crucial role. However, within this theoretical framework the installed base is understood as not just technical, like in most of the legacy systems literature. Work routines, organizational structures and social institutions are very significant elements of the installed base and may resist change attempts (Hanseth and Monteiro, 1997). Rather than pure technical artifacts, information infrastructures are complex heterogeneous actor-networks (Star and Ruhleder, 1996; Monteiro and Hanseth, 1995).

2.3.1 Evolution of information infrastructures

We use the information infrastructure metaphor in order to emphasize the challenges that information infrastructures pose to change attempts and the long timeframe for any development (what normally gets lumped together as ‘maintenance’). In formulating a theory of information infrastructures, the Internet has been used as a paradigmatic case (Abbate 1995; Hanseth, Monteiro and Hatling 1996), as well as studies of other infrastructural systems like the electric power grid (Hughes 1987; David and Bunn 1988). In accordance with the infrastructure metaphor we may see information infrastructures as ‘sunk’ and deeply embedded into our societies and communities. The sheer size and degree of embeddedness are one important reason that information infrastructures evolve gradually. Changes have to be linked to the previously installed base, either as extensions, revisions or replacements. To some degree, these large networks evolve beyond a single actor’s control, and are so complex that traditional approaches to managerial control and governance seem to have significant limitations (Hanseth et al. 2001; Ciborra et al. 2000).

2.3.2 Multiplicities and complexities of information infrastructures

In recent elaborations of actor-network theory (ANT), which is the analytical underpinning of the theory of information infrastructures, there is a highly relevant shift in attention. Law and Singleton (2005) outline a very useful chronology of ANT into three phases. The first phase of ANT studies described how networks of control were established; how scientific and technological stabilization and closure emerged (cf. Latour 1988). It is worth noting that the applications of ANT in IS are almost entirely based on this version of ANT. What Law and Singleton dub the second phase of ANT is characterized by a preoccupation with slowly evolving, gradually transforming networks (Law and Singleton 1995). An iconic representative is Laet and Mol's (2000) account of the Zimbabwe Bush Pump. Here they map out the continuous, evolving transformation of the pump as it get amended, extended and modified as it makes its journey across the southern parts of Africa. Its ability to embrace multiple identities, configurations, and shapes, or its 'fluidity' was crucial to its success, as it allowed its functioning in different environments. In contrast, the third and most recent phase of ANT highlights the essential multiplicity of networks and their dis-continuous changes. This multiplicity entails a recognition that objects do not merely vary according to perspective but "objects become ontologically complex, multiple and (in some cases) mutually exclusive" (Law and Singleton 2005:342). This perspective on networks, and by implication information infrastructures, focuses on how ordering efforts involved in the integration and standardization of information systems *relocate* disorder; order for one in one place is simultaneously disorder for another in another place. As Berg and Timmermans (2000: 6-37) point out:

"[T]hese orders do not emerge out of (and thereby replace) a pre-existing disorder. Rather, with the production of an order, a corresponding disorder comes into being...The order and its disorder, we argue, are engaged in a spiraling relationship – they need and embody each other"

Latour in a similar manner underline how ambitions and intentions are never realized:

“There is a drift, a slippage, a displacement, which, depending on the case, may be tiny or infinitely large” (Latour, 1999: 88)

Furthermore, due to the multiplicity and complexity of the underlying networks, the very ordering efforts in themselves may *produce* the disorder:

“[T]he two orders [referred to, i.e. two alternative clinical treatments] we have described produce the very disorder they attempt to eradicate” (Berg and Timmermans 2000: 45)

John Law makes a similar point, but pushes further by underscoring the ultimately dysfunctional nature of preserving the ambition of full integration with the implied completeness and perfection:

“So what’s the argument here? The answer is: it’s an argument about imperfection....That there are always many imperfections. And to make perfection in one place (assuming such a thing was possible) would be to risk much greater imperfection in other locations...The argument is that entropy is chronic.... Some parts of the system will dissolve”(Law, 2003: 11)

In sum, this third phase of ANT, largely unexplored in IS research, problematizes the nature and implications of key challenges related to information infrastructures: attempts to intervene and change may produce unexpected consequences; attempts to impose order in a collection of information systems through integration of multiple networks or standardization may only relocate or generate new dis-order (Hanseth et al. 2005). It underscores how complexities via non-alignment are neither transient nor accidental – but *endemic*.

2.3.3 Strategies for change: cultivation revisited

The conservative power of the installed base, its resistance against change necessitates an incremental nature of growth. Consequently, researchers have emphasized the role of pragmatic rather than ‘utopian’ strategies. When facing the challenges of design, realization and change of information infrastructures, evolutionary and iterative

approaches to seem highly appropriate and indeed inevitable. Design and change are involved and open-ended processes of socio-technical negotiations, which evolve according to a non-predictable dynamic. ‘Cultivation’ rather than ‘construction’ is suggested as a way to handle and live with the limits of managerial (or political) control over such phenomena (Ciborra et al. 2000; Dahlbom and Jahnert 1996). Rather than plan, prescribe and construct growth, it will seek to strengthen and nurture growth, through constant care, continuous assessment and a commitment to revise strategies that do not work well (Aanestad 2002).

In this paper we discuss challenges of organizational and institutional change project linked to technology implementation project on a large scale (the nation-wide health care sector). In addition to handling the challenges of size and scale through incremental strategies, however, we also need to address the sector’s institutional fragmentation as described above. Political legitimacy must be secured in a situation where there may be frequent political discontinuities, and a change project will need to navigate in the presence of foreign aid agencies and non-governmental organizations (NGOs) with various interests and agendas. This calls for approaches that are ‘on the guard’ continuously, and where threats and opportunities are monitored, assessed and reacted to on an ongoing basis.

The second phase of ANT as outlined above draws attention to the improvisational nature of development processes (Orlikowski 1996). The third phase substantiates the naivety embedded in efforts of embracing – “integrating” – comprehensive and dynamically shifting configurations of information systems. Integration, as a means to overcome a deep and self-reproducing source of heterogeneity is unattainable (in a strict sense) given such a perspective. This has obvious, yet largely uncharted, implications for management and control of information systems development processes through the source and type of complexities and risks involved.

In concluding, a relevant strategy will need to address the two core challenges identified above:

Earlier solutions, entrenched routines, prevailing perceptions and social institutions constitute and solidify existing practices, and cannot be changed in one instance. The historical, techno/socio/political 'installed base', of which legacy information systems is an important instantiation, need to be addressed drawing on evolutionary, small-step, gradual strategies.

The technical and institutional heterogeneity (in terms of number and kinds of actors, donor agencies, NGOs, official authorities etc.) with the ensuing fragmentation of information systems needs to be handled pragmatically. As no-one, including the national health authorities, are in 'control' in any strict sense, a relevant strategy cannot be based on a planning or control approach, but rather needs live with a reasonable level of non-integration.

Our empirical contribution is to exemplify the challenges associated with these dynamics, and to analyze them as instantiations of historicity and heterogeneity. We thus aim to contribute theoretically by fleshing out the implications of the theoretical basis for our work, and offering examples of actual strategies for approaching and addressing these challenges.

3. RESEARCH APPROACH

3.1 Research design

Our empirical material describes attempts to change the routine health information systems in Mozambique, in mainland Tanzania and in the Indian state of Andhra Pradesh. Due to its size and the provincial autonomy in terms of health care administration we focus on the state of Andhra Pradesh rather than India as a whole (see table 2). These three settings are discussed in a cross-national comparative perspective highlighting important similarities and differences relevant for our study. Some similarities that are of vital importance in shaping the health care sector are: The countries have all been under former colonial rule and are still recipients of foreign aid (although to varying degrees), some of the major health problems are similar, and the communication and transport infrastructure are weakly developed outside the major cities. The action research project HISP (Health Information Systems Project, which is described further below) is involved

also in other countries, among which South Africa and Ethiopia could be possible candidates for this study. However, the three settings we describe here share the characteristic of a rather centralized and hierarchical health care administration, while in South Africa the provinces and in Ethiopia the regions enjoy considerable autonomy, leading to a different set of issues and concerns. In both Mozambique and Tanzania there was a nation-wide, partly computerized general health information system, while Mozambican health workers also had to report through additional reporting systems. In India a plethora of paper-based reporting systems were in use, but not one general system. These three settings thus pose various configurations of the problems related to legacy systems and fragmentation, and most importantly: examples of different strategic approaches to these challenges. Moreover, the timing is also different: HISP has been present in Mozambique since 1999, in India since 2000 and in Tanzania since 2002.

The Health Information Systems Program is a large-scale, ongoing action research project that has as its primary goal “to design, implement, and sustain Health Information System following a participatory approach to support local management of health care delivery and information flows in selected health facilities, districts, and provinces, and its further spread within and across developing countries” (Braa, Monteiro, and Sahay 2004; 343). It has, to use Zuboff’s (1988) vocabulary, an ambition to *automate* selected (manual and paper based) routines, and, with considerably more difficulty, to *informate* clinical decision making through decentralization. HISP is a relatively loose network of different countries, or more specifically, of institutions within these countries. Its goal is explicitly related to supporting the peripheral or local levels of health care, but in order to achieve this, the national health authorities must become involved. Thus, central to the network is formalized and contractual agreements between universities and health authorities, including two joint Master’s programs (in public health and informatics) and a PhD program. The HISP team at the University of Western Cape in South Africa is the principal hub in the network of developers for the District Health Information System (DHIS) software which is being spread through the network, to the other partner countries which include India, Mozambique, Tanzania, Ethiopia, Malawi, Mongolia, Vietnam and Nigeria. The DHIS software was initially Microsoft Access based but is

made available free of cost. HISP is currently in the process of moving to an open-source platform, while the functionality is continually extended. There is also a platform independent and web-enabled version by globally distributed teams of informatics students and professional software developers. More details on the history, the institutional basis, the organization, and the funding arrangements of the HISP can be found in (Braa, et al., 2004; Braa and Hedberg, 2002; Braa, Heywood and Shung Kim, 1997; Braa et al. 2001 and at www.hisp.org).

3.2 Data gathering

The HISP is a long-term and distributed action research project, where several actors beyond the authors of this paper play key parts. We harbor a broad understanding of 'action research' as a goal directed research methodology where the aim is to understand large socio-technical systems in order to change them (Baskerville and Wood-Harper 1998). In our accounts from the three countries we build upon multiple data sources, and we find it necessary to elaborate on some aspects related to this.

The HISP activities within a new country have largely followed the same template. In accordance with the action research cycle, first the aim was to generate an understanding of the actual situation through conducting surveys and situational analyses, both in health facilities at the peripheral level and in administrative offices at higher levels. The observations from these surveys were recorded and analyzed within an interpretive framework (Walsham 1995; Klein and Myers 1999), and reported in separate publications. The actual methods used in these surveys were: interviews, (participant) observation, questionnaire, and document analysis. Though varying from country to country, the surveys would initially be centered on general issues of computer literacy and health reporting systems, later to be complemented with more focused analyses on e.g. data quality issues and actual work practices at the peripheral health facilities. Also the computerized systems in more central locations were examined. When appropriate we will refer to published reports from these studies, while it should be noted that most of the paper's authors were also personally involved in these initial phases in one or several of the countries.

Based on the findings from the initial studies, the intervention phase commenced. While this was different in the different countries, it usually included: Participatory workshops with health care personnel from pilot sites, import of the software and subsequent translation, adaptation and customization. In conjunction with the implementation of the software, onsite sessions and training was offered to the prospective users. The participants in the HISP training venues has been a source of data on health sector achievements, challenges and shortcomings, and these meetings has helped to document the daily experiences of health professionals. As training is often accompanied by follow-up activities, it has been possible for HISP members to observe in situ the main factors affecting the performance of HIS in its dynamic relationship with health workers, from the district managers to laboratory clerks. This phase of entrance and start-up is also fairly well documented, especially for Mozambique where several of the doctoral candidates have submitted and defended their PhD theses (Chilundo 2004; Mosse 2005). Most of the authors have also been personally involved in this implementation phase, although with different focus and work tasks.

In this paper our focus will be what we see as a third phase; that is on the actions needed in order to ensure sustained presence in the countries after the initial intervention. Here is it also that we depart from the orderly schematic depictions of action research with its iterative cycles of analysis, intervention, and evaluation. In our setting this did not happen in well-defined and planned cycles, neither was there any stable definition of who the 'clients' were at all points. There was much more turmoil and ad hoc actions, as emergent opportunities called for a mix of planned and non-planned action. This was the case for the HISP team administration locally (within one country), but related to the global HISP network. In this paper our main emphasis is to describe and focus on this 'navigation' work as a symptom of general problem complexes facing IS in developing countries. Thus we base parts of our account on experiences from the ongoing daily work of the authors who are the central members of the HISP teams from Mozambique and Tanzania. In addition to structured and planned research work their daily work involves technical problem solving, sorting out financial matters, and political negotiations. In Mozambique, the collaboration with the Ministry of Health (MoH) and provincial and district

directorates of health has been intensive since 1999. Copious amounts of data have been gathered in the form of meeting minutes, reports, and presentations. The Tanzanian authors of this paper makes up the Tanzanian HISP team, and have thus played a central role in similar collaboration with the national health authorities. Comprehensive empirical material is thus available for these two countries. However, while India has been visited by two of the authors for fieldwork, we here have to base our account on secondary data sources to a larger degree. Our account of HISP India's history is mainly based on published research papers, and in addition we have performed informal interview and email queries with HISP India team members on particular details.

Table 1 Overview over the type of empirical material used in this paper together with an indication of the role of the authors in the various phases of HISP

	Analysis phase	Intervention phase	Sustaining HISP
Mozambique	Survey 1999 reported in (Braa et al., 2001) <i>(Authors involved)</i>	Field work reports and research papers <i>(Authors involved)</i>	No published accounts, reliance on primary data sources <i>(Authors involved)</i>
Tanzania	Surveys carried out since 2002. (e.g. Mukama, 2003) <i>(Authors involved)</i>	Field work reports and research papers <i>(Authors involved)</i>	No published accounts, reliance on primary data sources <i>(Authors involved)</i>
Andhra Pradesh in India	Initial analysis 2000 (unpublished report) <i>(Authors not involved)</i>	Research papers <i>(Authors briefly involved)</i>	Research papers, interviews with HISP India members <i>(Authors not involved)</i>

3.3 Data analysis

We thus build our accounts on the authors' ongoing sense-making when faced with a multifaceted reality. We construct a narrative structure, which by necessity is a post-hoc rationalization that is deliberately created to focus on some aspects rather than others. We are all HISP 'partisans', a fact which fundamentally shapes our account. We believe that the fundamental assumption that changes in the health information systems is needed and beneficial is widely shared. Conceptions will differ with regard to the actual way of doing this, and not all actors see HISP as an optimal solution. The authors' shared goal is on sustaining HISP activities, and we belong to an academic community with more or less shared theoretical resources and understandings of the challenges involved. Thus our accounts may very well be contested by other involved parties, both with regard to their fundamental composition (e.g. in terms of cause and effect-statements), but also the

interpretations that we offer. We claim to have maintained a close attention to the empirical material, and while we do not claim any intellectually or morally superior role, we still want to maintain the relevance of our admittedly situated and partial account.

Numerous people are associated with the HISP project in very diverse roles. Some are intensely involved in fieldwork, surveys, implementation, user training, and ongoing support. Other researchers work with more directly towards the health sector's management in order to secure political and financial support. The two Norwegian authors are associated with the project mainly through supervision responsibilities, but supplemented with field visits. In addition there are multiple Master students involved in various countries, as well as professional software developers hired on a contractual basis (see table 2). The views and interpretations are diverse, and not all involved HISP members share the same opinions about the evaluation of HISP, the quality of DHIS or the best strategy to choose. When presenting the empirical material, we will identify and discuss where we believe some of HISP's weak spots are. We have attempted to validate our interpretations in various ways, first and foremost among fellow HISP members, and through the ongoing dialogue with the Ministries of Health, particularly in Mozambique. The composition of the team of authors, with some authors intensely involved and other distant from the field also allowed for reflections on interpretations.

Table 1 The different roles and number of participants in the HISP network

Role/Country	Mozambique	Tanzania	South Africa	India	Vietnam	Ethiopia	Norway
Master Students	2	2		1		6	10
PhD students	4	3	1	1		4	2
Researchers				1			6
Consultants	1				1	1	
Hired programmers	2			8	5	5	
Vendors			1		2		

Our understandings of the challenges have been shaped also by the process of applying the conceptual and analytical tools presented in section 2. Our accounts and the interpretation of them have evolved along a route similar to the three phases of Actor-network theory. Our first initial approach was on understanding HISP as a new actor in

relation to the existing 'installed base' of previous paper-based and computerized systems. A better empirically grounded understanding of the challenges led us to emphasize the need for incremental and gradual strategies, in line with the second phase of ANT. However, in reviewing more recent theoretical contributions, our focus was reshaped to also encompass the inherent, and inescapable, heterogeneity of the health care sector. In this continuous process or reorientation we gradually became able to conceptualize also the generic nature of these challenges.

4. THE HEALTH INFORMATION SYSTEMS

In this section we will describe the historical background for the routine health data reporting systems, as well as the current perceived problems with these systems. (Due to the existence of a computerized information system in Mozambique and Tanzania, we will provide more detail on these two countries). We then proceed to describe the interventions from the HISP action research project.

Table 2 Cross-national comparison of country profile, health care sector and status of health information systems.

Country profile	Healthcare	Current computerised HIS
Mozambique		
Population: 19.2 million (UN, 2003)	Life expectancy: 37 years (M), 40 years (W). Under-5 mortality rate 158 (2003)	SIS-Prog: Dbase application launched in 1992 with external support aiming to computerize the SIS and support the needs of the entire organization. Only Immunizations (EPI) and Mother and Child Health (MCH) modules were computerized. Source code and documentation damaged. System can not be reinstalled, modified or extended to cope with medical, technological, or organizational changes.
Area: 812,379 sq km	Malaria, TB, HIV/AIDS are the greatest threats	
Official language: Portuguese	Centralized health sector, strong presence of donors and NGOs	
GNI per capita: US \$210	SIS: national health data reporting systems launched 1982, with the aim of integrated and uniform reporting. Consists of tally sheets, report forms, register books, procedures and definitions. Local collection, aggregation and upward reporting of data with little feedback and local use of data. Severe delays and data quality problems, high work load on health workers	Other computer systems: BES (weekly disease surveillance), HIV/AIDS, TB, pharmacy data, human resources, maintenance data, logistics, stocks, EpiInfo (epidemiology), SPSS, SIMP (Excel-based integration of other data)
Battered by colonial rule, civil war, floods and famine. Transport and communication infrastructure weakly developed outside the cities. One of the poorest countries in the world, heavily reliant on foreign aid.		
Tanzania		
Population: 34.4 million (2002 census)	Life expectancy: 42 years (M), 44 years (W) Under-5 mortality rate	MTUHA: MS Access based, developed locally by local vendors,

data) Area: 945,087 sq km Major languages: English, Swahili GNI per capita: US \$290 Transport and communication infrastructure weakly developed outside the cities. One of the poorest countries in the world, heavily reliant on foreign aid	165 (2003) <i>Malaria, TB and HIV/AIDS are major killing diseases</i> HIS centralized with four hierarchical levels MTUHA: national health data reporting system developed 1991 to replace various parallel subsystems. Consist of 12 register books and three types of tally sheets, all in a mixture of Kiswahili and English Local collection, aggregation and upward reporting of data with little feedback and local use of data. Severe delays and data quality problems, high work load on health workers with no motivation	but source code and documentation not retained by the MoH. All maintenance and extensions need to be re-negotiated and occur on a contractual basis. Other systems: STD, HIV/AIDS, TB and leprosy, etc. Specific reports collected by program managers, based on data from MTUHA forms but using forms different from MTUHA.
India (Andhra Pradesh)		
Population: 75 million (AP) Area: 2,75,068 sq km (AP) Major languages: English, Hindi, Telugu (AP) GNI per capita (India): US \$530 Varying infrastructural conditions. Independent democracy since 1947, economic reforms have led to dynamic economy, but still major poverty problems. Aims at reducing aid dependence	Life expectancy (India): 63 years (M), 65 years (W). Under-5 mortality rate 87 (2003) India has a third of world's new TB cases, high child and maternal mortality, and has seen a rapid increase in HIV/AIDS infections Health care administration is the responsibility of each state, but within the state HIS centralized with five hierarchical levels. Bureaucratic. In 2000: No overall reporting system, but ca. 1200 data elements were collected and reported in ca 40 manually generated monthly reports. The Primary Health Centre is the main source of data. massive duplication of data and variety of reporting formats constituted high work burden	No computerized system. Ongoing implementation of FHIMS and DHIS Multiple separate report for vertical programs

4.1 Mozambique

4.1.1 Country profile and health care sector

Having inherited a completely shattered health system from the Portuguese, after independence in 1975 Mozambique's health care policies and strategies were based on the PHC approach (WHO 1978). The attempts to build a health service sector were seriously hindered by the Civil War, which lasted until 1992. The country is still in a pre-transitional demographic state, with a predominance of infectious and parasitic diseases, linked to limited access to health care, poor sanitation, inadequate nutrition and unsafe water supply, thus compounding for the high morbidity and the mortality of the population. Since 1992, tremendous efforts have been put in place to revamp health services provision, and along these efforts, management and planning have received paramount importance. With its 19 million inhabitants, Mozambique is among the poorest countries in the world. The Health Information System is recognized by the Ministry of Health as critical for the success of health programs (MISAU 2000). It builds on an installed base consisting of the paper-based information system called SIS, dating back to 1982. The SIS covers governmental health facilities at the primary and secondary levels of health care, while private or NGO-run facilities do not use the SIS reporting system. Data is collected at health units, aggregated and collated at district level, and transmitted to provincial and then national level. Most of the data collecting forms are based on the needs of specific vertical programs, e.g. immunization or mother and child health. Major problems are related to data collection and reporting: absurd values proclaiming excellent program coverage in most districts of Mozambique indicate that cooking of data is an established practice. 760% measles coverage was once reported for a northern district a few years ago; although this is an extreme case, coverage values ranging from 100% to 250% are indeed not uncommon. The data collectors are typically nurses who have to deal with data chores besides their regular work and often after work hours. The lack of career paths in health information means that dedicated personnel, catering for activity data as their exclusive occupation is rare, although this would significantly boost quality and use of information generated in the health sector.

4.1.2 Current computerized health information system

In 1992 the SIS was complemented by a computerized system, the SIS-Prog, which was developed by an expatriate who has since left. By 1994 the SIS-Prog was used in the 11 provincial Health Directorates and at the national level (in the Ministry of Health, National Health Information Systems (NHIS) section). The SIS paper forms are collected from districts and the data are entered into the SIS-Prog at the provincial Health Directorate, which then reports to the MoH. The computerized system was intended to cover 10 of the common paper forms for regular reports, but only 4 forms are computerized fully. The computerized forms belong to the immunization and the mother and child health programs. The system is based on dBase III, DOS-based, running on Microsoft Windows 95. The system reflects its top-down design, e.g. the unit of analysis is the provincial level (Braa et al, 2001). The Mozambican Ministry of Health does not have the source code to the SIS-Prog; it cannot be found anymore, and this poses several problematic constraints. One is that the system is running on old and slow computers, which constitute an extra work burden, and it can not be installed on newer computers. In order to create graphical reports, staff currently prints out the data from the SIS-Prog and manually re-enter the numbers into Excel sheets. Another constraint relates to the data elements, which are hard coded into the system and thus not changeable. The practice of hard coding of such semi-permanent data (e.g. organizational units, data elements or reporting frequencies) makes the systems inflexible in itself. Together with the lack of national control in the HIS development process and the consequent reliance on expatriate staff it leaves the authorities with little room for flexible improvement of the systems. Due to changes in the paper forms which have not been replicated in the data entry screens in the computerized system, possibly up to 25% of data are entered into the wrong data fields (Mavimbe 2003). The hospital form was not included in the SIS-Prog and has never been used in its paper form either. This partial coverage has resulted in the use of many Excel forms to capture hospital data in the provinces. The computerized systems themselves also contribute to the situation of low data quality, as validation and verification procedures are missing. In the SIS-Prog system the default value is 'zero' instead of 'null'. This makes it difficult to say whether the actual report contained zero as its value or whether there is just a missing number due to non-reporting.

Mozambique's aid dependence is extremely high, and it remains the largest single recipient of foreign assistance in Africa (Chilundo 2004). During the civil war, external agencies and NGOs carried out emergency health interventions, the legacy of which is continued strong donor presence and weakly developed national structures for comprehensive planning and management. The consequence for the health information systems is that in addition to SIS and SIS-Prog there are multiple other reporting systems, most of them belonging to vertical, disease-specific programs: malaria, tuberculosis, leprosy, HIV/AIDS, and the weekly epidemiological bulletin (BES) for notifiable diseases. Besides general concerns over waste of resources, the multiple reporting systems create an unacceptable high work burden on already overworked primary health workers.

4.1.3 HISP in Mozambique

HISP in Mozambique started officially in 1999 with the Eduardo Mondlane University and the Ministry of Health as partners. Prior to that a pilot project funded by NUFU had surveyed the level of computerization in some districts, with a particular emphasis on health care (Braa et al. 2001). Based on the contact established here, formal cooperation was established. However, despite the commitment from the Ministry of Health, the HISP work was for some time not backed up with strong official support. There is consequently no full-time staff employed within the HISP program and attempts to have the MoH place liaison officers have been protracted. A major part of HISP activities, including training and follow-up, is carried out by doctoral and master students as part of their research duties.

Three districts in three different provinces were selected as pilot implementation sites, and the District Health Information System (DHIS) software originating in South Africa was translated from English to Portuguese and adapted to fit with the Mozambican context. The initial strategy was to replicate the data elements and reports from the existing SIS-Prog, while carrying out training workshops for health workers at district

and provincial levels. Training focused on data quality, use of information for local decision-making and use of DHIS software to handle data.

Mozambique was the first country after South Africa where the HISP was established. Contrary to the relative independence of South African provinces in terms of decision making, the Mozambican health sector is more centralized. Both donors and the health authorities focused on the provinces as scenes for reform and improvement, while the HISP agenda was to focus on the district level. This led to the realization that there was a dilemma with the bottom-up approach that needed more careful attention. Through the work of Master students, the old SIS-Prog database was analyzed, migration tools were developed and data was exported into a full national database (Skobba 2003; Lungo 2003). This allowed demonstration to the Ministry's and province administrations officials of the added functionality available with the software. Further customization ensued, with changes to user interfaces, improvement of reporting tools and stable links to SIMP, in response to requests from the Department of Health Information at the Ministry of Health. A GIS tool is being finalized and has captured interest from provincial managers. The utilization of the capacity presented by doctoral and master students has benefited the process of localization of DHIS software, and also ensured continuing involvement and awareness building among students and lecturers.

4.2 Tanzania

4.2.1 Country profile and health care sector

Tanzania has around 35 million inhabitants. Despite political stability and ambitious political and economic reforms, its aid dependence is considerable. Inadequate immunization, drug shortages, poor nutrition and unsafe drinking water make the population vulnerable to diseases such as measles, dysentery, cholera and tuberculosis. Malaria remains one of the nation's biggest killers, however HIV/AIDS has spread rapidly causing tuberculosis to become another threat. There are four administrative levels, where village health posts that provide basic preventive services, dispensaries and health centers comprise the lowest level, and the other levels correspond to district, regional and referral hospitals. Vertical programs like the Expanded Program on

Immunization, Essential Drugs Program, TB and Leprosy, Control of Diarrhoea Diseases, Mother and Child Health previously had separate and parallel systems of data collection, compilation and reporting (Mwangu, 2003). The national health authorities regarded this collection of different ad hoc systems as too fragmented, top-down-oriented and ineffective for local decision-making. Tanzania's current health information reporting system, called MTUHA, was intended address these issues. When conceived in 1991 it was intended to cover all levels in the health sector (health facility level, district level, regional level and national level), to include all vertical programs (i.e. stand-alone, disease-specific programs) and private facilities, and to support the agendas of health reforms through decentralization (MoH 1993). The roll-out of MTUHA was accomplished in 1997. A health facility compiles health data collected at the health units and from outreach activities including home based health delivery services and services at the village health posts. At the facility level, there are twelve registers and three types of tally sheets, and all registers, tally sheets, report forms and manuals are in a mixture of Kiswahili and English. Despite the aims that the MTUHA would be developed primarily for use at the health facility, to provide information suitable for local management and planning, its actual design process did not include the end users, but mainly MoH officials and donor representatives (Mwangu 2003). Only the MTUHA forms are currently used for data collection, but based on these data also program-specific reports are manually generated and collected by program managers.

4.2.2 Current computerized health information system

Simultaneously, in 1992, a software developer developed a MTUHA database application based on dBase IV, which was implemented in the MoH headquarters as well as in the 20 regional offices of the Tanzania mainland. During the early period of its use, between 1993 and 1995, several software bugs were detected and change requests were collected. The first developer had left the country and therefore another foreign developer was contracted to make an improved version of the MTUHA database to include new needs.

In 1997 the paper-based MTUHA system was subject to a major evaluation and several recommendations for change were given. For example, new reporting forms were added

and the reporting frequency for health facilities was changed from monthly to quarterly. As a result, changes in the DBASE IV system were required, but the developer suggested it would be wiser to start a new development project instead of changing the old version. Further, the developer proposed the development of new software by a software company based in Dar es Salaam with development costs paid by the donor. The software company based on its expertise chose to develop the software based on Microsoft Access. The new system was developed over 7 months in 1998 (Kimaro and Nhampossa 2005). The MTUHA software in use is currently incomplete, not all data can be entered in their appropriate formats. For example, form F005 in the software allows entering only data from government owned health facilities, but not private health facilities, which also report the same data format. Other examples are mismatches between data fields of the paper forms and the database capture forms. The data entered through the form F002 can not be viewed; there is no report that shows them (Lungo and Nhampossa 2004). As the Ministry of Health did not own the source code of the software, and commanded no funds toward updating it, changes were not made until recently, when a new development project has commenced.

4.2.3 HISP in Tanzania

In July 2002 HISP started piloting its activities in two health districts of Bagamoyo and Kibaha. This happened in collaboration with the national health information systems unit in the Ministry of Health. The activities included implementation of the DHIS software and training on computer and DHIS use, as well as conducting research on data collection, flow and use. While continuing to provide user support in the two pilot sites, in 2004 the project was expanded into three health districts in the city of Dar es Salaam (Ilala, Temeke, and Kinondoni).

Although the HISP team has tried to involve stakeholders in all levels, there is not yet an institutional strategy to assist HISP with financial or human resources. HISP is currently staffed by three PhD students financed through Norwegian scholarships, and is consequently perceived as 'just a research project'. On the one hand, MoH officials said they were ready to give support to HISP. On the other hand, while running the DHIS and

MTUHA database in parallel, the MoH officials seem reluctant to switch over to an alternative system because of fear of losing reputation. "...we do not want to move quickly this time with something which we have not realized its output, the policy makers need to be convinced of the DHIS..." (HMIS unit manager). The decision to allow the DHIS to run in parallel with the MTUHA has had negative impacts for HISP, as the MoH support has been diverted. This goes for lack of participation in the design process, the MoH taking decision which totally excludes DHIS, as well as creating increased work and confusion for health workers as to which system they should use.

4.3 The reporting systems in Andhra Pradesh, India

4.3.1 Country profile and health care context

The responsibility for provision of public health care services in India is decentralized to the states. Within the states the health sector is relatively bureaucratic and centralized, with five administrative levels through which reports flow. Compared to Mozambique and Tanzania, India's dependence on foreign aid is very moderate, and the official policy aims at reducing this dependency even further and ultimately to move from being an aid recipient to becoming an aid donor. In 2004 the external proportion of financial resources for public health expenditure was a marginal 3.6 %. Still major health problems persist mainly related to poverty problems and communicable diseases. The maternal and child mortality rate is high, and tuberculosis and HIV/AIDS have a significant impact on health. In the Indian state of Andhra Pradesh around 1500 Primary Health Care Centers and around 7500 Sub Centers cater for the 75 million inhabitants. Several vertical health programs exist and are administrated by the State Directorate of Health, including the family planning, malaria, leprosy, blindness and tuberculosis programs. The programs are integrated at the point of service delivery, but maintain separate reporting systems.

4.3.2 HISP in India

Around 2000 there was no state-wide general reporting system (comparable to the SIS and the MTUHA) in Andhra Pradesh; neither was any computerized systems used. A situation analysis by HISP members commencing in December 2000 concluded that staff at the primary health centers was collecting around 1200 data elements and generating

around 40 reports manually each month (e.g. ‘Immunizations’ and ‘Sterilizations’ reports). There was a high level of redundancy in the datasets; data was collected repeatedly to comply with the different report formats, and data was collected even for programs that had long been wound up (Puri et al. 2004). These findings formed the basis for a participatory process of redesigning the reporting system and identifying a Minimum Data Set. By September 2001 the more than 1200 data elements had been reduced to around 400, and the reports had been restructured and reduced to 10 (Puri et al. 2004). In January 2001 these reports were implemented in nine Primary Health Centers in Kuppam constituency in Chittoor district, and a partnership was established with a local computer company that would be responsible for training, providing local support and software development. The DHIS software was adapted and translated to Telugu, the main local language. The main routine reports were automated so that health workers would see some value of the software to their everyday work, and also other kinds of reports were created. This was both specific reports as designed and requested by the district management, and other reports that would facilitate local analysis. (Nhampossa and Sahay 2005).

The introduction of the HISP project was linked to a central politician; so it came in through ‘the political door’, (Braa et al. 2004). This fact strongly shaped its future trajectory, for example the decisions related to its expansion was very much shaped by the ad hoc response to political matters (Nhampossa and Sahay 2005; Sahay and Walsham 2005). Soon HISP encountered challenges from another computerization project that was supported by the health bureaucracy in the state. The FHIMS (Family Health Information Monitoring System) project was funded by the World Bank and was geared towards collecting patient data rather than statistical routine data. FHIMS is organized around household records containing information on immunization and disease statistics etc.. As part of the FHIMS project all of the state’s around 1500 PHCs would be equipped with PCs and dial-up connection to the district servers. However, HISP could be perceived as a competitor for this project, and the future of HISP in the state seemed threatened. Rather than challenging FHIMS, a strategy of compromise was followed, and it was proposed to integrate the DHIS software with the FHIMS system in a way that was

seen as relatively non-interfering with the FHMIS software. The strategy of offering DHIS as an added value was successful, and provided HISP with an opportunity to ‘ride on the back’ of FHIMS during its expansion to the whole state (Braa et al. 2004).

4. DISCUSSION AND ANALYSIS: DILEMMAS OF LEGACY AND FRAGMENTATION

In this analysis we highlight two selected themes that emerge from the case narratives:

- *Historicity*: the genealogical character of the ‘installed base’ of work, practices and technology, i.e. how historical sediments or imprints of the past live on through various manifestations
- *Heterogeneity*: the sources and implications of the fragmentation and lacking integration of the different information systems

This needs to be recognized as an analytical distinction motivated primarily for reasons of clarity of the presentation. In its empirical and dynamical unfolding, the two themes spill over.

4.1 The historicity of information systems

4.1.1 The social fabric of the ‘installed base’

The notion of ‘installed base’, despite its connotations to a purely technical notion, is in the theory of information infrastructures as outlined in section 2 above a socio-technical notion (Star and Ruhleder 1996; Hanseth and Monteiro 1997). It makes perfectly good sense to talk about the installed based of the social, and the case of Tanzania illustrates this well.

The original intentions of the Tanzanian MTUHA system were to integrate the various disparate systems used for the vertical health programs, to support decentralization, and to facilitate local ownership and use of data. These visions were not realized in the development of the MTUHA, which today is an inflexible system with partial coverage.

We see the deep and long-standing inequalities between aid recipients and aid donors as one of the reasons for this. For example, in the Ministry of Health (MoH) local

competence was insufficient both in regard to systems development and project management, as well as contract negotiations. Within the existing socio-political hierarchy the funding donor commanded the financial resources and cooperated directly with the system developer with relatively little involvement of the Tanzanian MoH (Kimaro and Nhampossa 2004). The prescribed (and accepted) role of MoH was that of a receiver, who should not interfere with the process. In the words of the manager of the Health Information System Unit:

“What the MoH wanted was just the software and we did not bother with its specifications”.

This resulted in a less than optimal situation concerning user participation during systems design and ownership of the system and maintenance responsibility. Currently the MoH does not own the source code, and has to raise additional funds if errors shall be corrected or the system shall be updated. The persistent, pervasive and sedimented character of such inter-institutional arrangements warrants the label of an ‘installed base’.

The social, organizational and institutional aspects of the installed base may also partly explain the limited success of HISP in terms of stimulating local data use. The fact that most health facilities are understaffed and inadequately financed, often in addition to being remotely located, has made it difficult to organize training of health workers at health facility level. However, even when training has been conducted it may not have been as effective towards changing work practices as was expected. For example, since the data compilers may be trained health workers who are involved in direct health service provision, and these primary work tasks and other duties take precedence over documentation and computer use (Mosse and Sahay 2003). Over time this leads to little practice with the system which can ultimately lead to forgetting about the DHIS’s functionality. Follow-up visits to Tanzanian health facilities in the two districts where DHIS was first installed showed that the trained health workers perceived the DHIS as just a tool for storing data, and that no attempts had been made to use the data for local decision making. On the one hand this problem is related to education and lack of particular skills of statistics and data processing. On the other hand this is a consequence

of the current form of organizing the health service provision. Currently, there is a separation between the data compilers, who only process data, and the managers who ideally should use this information for decision making. The data compilers interpret DHIS as something useful for their primary work tasks, i.e. as a data repository. However, in general there has been little commitment towards HISP from the district management. Health information officers have participated in the training programs of HISP, but not district managers, since they claim to never have time. In addition, we have seen examples of opportunistic behavior, where people who are not involved with the data collection, participate in order to get the training allowances. The socio-technical installed base in this context also comprises kinship and patronage networks, a characteristic that may further undermine top-down and formalized change attempts.

The fact that the course participant is not always the person who is responsible for data collection, leads us onto an important problem area. HISP's first intention, to improve the existing data reporting practices, seems to be easier to achieve than the second intention: to stimulate local data use, decision making and management. The first of these steps replicate the existing system and thus requires less changes of the installed base than the second, which depends on the reorganization of roles and responsibilities. The second goal is thus more difficult to achieve, as it does not only entail these challenges related to organizational politics, but also extends beyond the sphere of control of HISP, or even of the national health care authorities. It will require policy and regulatory changes, as well as the realization of the proclaimed decentralization. (i.e. actually redistributing both power and financial resources). This also involves the donor and aid organizations practices related to funding arrangements. For example, it turned out to be almost impossible for district managers to follow a HISP suggestion and change the reporting frequency from quarterly to monthly in order to make it easier to trace poor quality data.

Even minor changes to the installed base may be hard. The work required to establish the DHIS as just a data repository was significant, and comprised training on computer use and the DHIS software, as well as ongoing software and hardware support. Offering the data compilers a new tool for their job may not seem a large step, but registering data on

a computer rather than in paper forms or books may actually be more cumbersome if we consider low computer literacy, frequent power shortages and other well-known features of a rural, developing country context. However, this ‘investment’ may generate one short-term benefit, specifically related to the excessive work demands that arise from the multiple vertical programs with their own reporting requirements. With the DHIS software it is possible to automatically generate diverse reports, which can be tailored to fit with each health program's or actor's format requirements. Thus, if the data are entered into DHIS, the health workers are able to generate the required reports with less work.

The cultivation strategy for the development of information systems need to incorporate an evolutionary perspective of the change of also the social as well as the technical. The HISP approach is to simultaneously address the need for practice-relevant knowledge during training courses, as well as to contribute to the building of general competence through study programs for Master and for PhD students and health care officials.

4.1.2 Fragmentation stemming from the installed base

The case of SIS-Prog in Mozambique shows how the problems of legacy systems and fragmentation are directly related. The inflexibility of the legacy system, SIS-Prog, led to fragmentation. This happened along at least three routes. As Latour points out, actions are overtaken by their intentions thus producing unintended consequences:

“that action is slightly overtaken by what it acts upon; that it drifts through translation; that an experiment is an event which offers slightly more than its inputs” (Latour 1999:298)

The first way in which the SIS-Prog lead to systems fragmentation is quite straightforward. As the ‘SIS dream’ of complete coverage never came close to realization, the previous separate reporting systems from the vertical programs continued to live beside SIS. While there is a general recognition that this is a suboptimal situation, neither HISP nor other actors have addressed the issue of systems’ integration with full force. Secondly, since the system (SIS-Prog) cannot be extended or updated, actual

changes in the health care provision will not get replicated in the system. Examples of this are facilities that are opened or closed, or new treatments that are offered. For example, in 2001 the Hepatitis B vaccine was introduced, to be administered as a joint shot together with the DTP (Diphtheria, Tetanus, Pertussis). The SIS paper forms were not timely updated and the data entry screens in the SIS-Prog system could not be changed to accommodate data on the new tetravalent vaccine. The result was not being able to ascertain how many children were vaccinated in the intermediary phase on the introduction of the new vaccine, as new and old SIS forms coexisted and the structure of SIS-Prog made it impossible to add new fields. Different ad hoc solutions to this dilemma were used and the result was non-standardized reporting, i.e. fragmentation. Similar examples of consequences of fragmentation due to legacy systems are well known also with information systems in the North.

The third fragmentation mechanism is also a direct consequence of the inflexibility problems associated with SIS-Prog. New applications were developed to cater for the needs that SIS-Prog could not address. Today there are separate applications for financial data, human resources, drugs, logistics, epidemiology reports, etc; in total 13 computerized systems are in use within the Ministry of Health (Nhampossa 2004). In addition there are other non-computerized systems, so that e.g. data collected on malaria could be reported through up to four different reporting channels (Chilundo and Aanestad 2004). The resulting multiplicity of systems is depicted in the figure below.

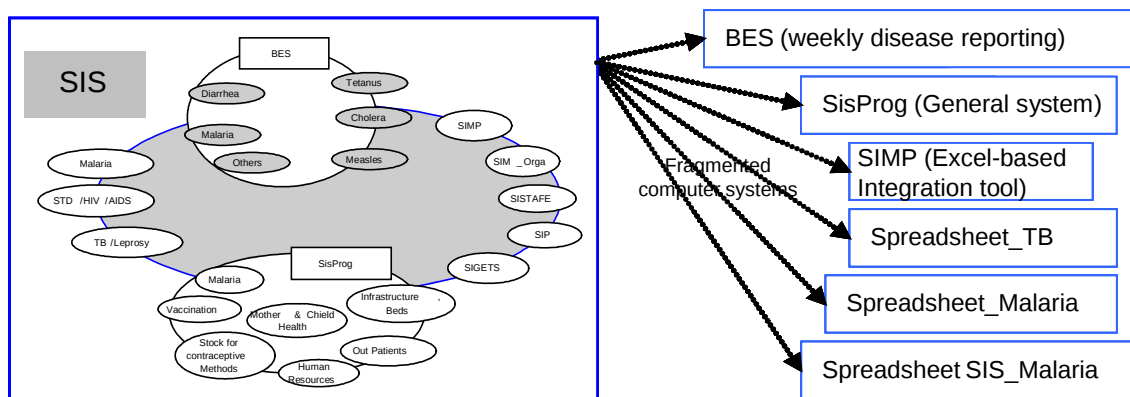


Figure 2 Multiple, fragmented information systems in the Mozambican health sector

When confronted with this 'spaghetti' of systems HISP employed a gradual strategy. It was gradual both in terms of functionality of the DHIS software and in terms of geographical spread. As a starting point the HISP team in Mozambique replicated the existing data entry screens and form of SIS-Prog, which covered the Immunization and Mother and Child Health programs. In one sense this was an added value in itself because the new software was more flexible than the old. If DHIS replaced SIS-Prog, one could now add or remove health facilities, reporting frequencies could be adjusted, and data elements could be changed. This modification could not be done to SIS-Prog since the source code was not available.

This strategy to a certain degree relied on promises of future benefit from the software. Demonstrator sessions were conducted for central officials in order to get clearance and access to health care facilities. Prior to these sessions real data from the existing system (SIS-Prog) were used to populate new DHIS databases (Lungo 2003; Skobba 2003). This allowed HISP researchers to show how the software would help improve the analysis of data. However, full implementation at all facilities (e.g. in a province) would be necessary before benefits were visible to the top management. As HISP was starting in three pilot districts in three provinces, it encountered a dilemma related to this gradual bottom-up approach. Later the strategy was modified through the establishment of 'cluster centers'. The office in a district center with relatively stable electricity and some regularity of transport was computerized and served as a hub. Staff from other health centers/districts were supposed to come to this center to do the data entry into the computers.

Another step in the gradual strategy was to link to SIMP via a gateway. SIMP is a crucial spreadsheet-based application used to integrate the data from all the other subsystems, and was developed to satisfy the need of data for planning purposes at the provincial and national levels. The idea behind the gateway was that the useful but frail SIMP tool can continue to be used, while DHIS can replace SIS-Prog behind the stage. Currently the DHIS can transfer data to SIMP; and this function has been tested in the Inhambane province where the full implementation of DHIS is under way at a faster pace than in the

other two pilot provinces. Then the next step can be taken from there, and when large enough, DHIS can also replace SIMP. Technically this is already possible, DHIS can create all of the required reports, but this version has not yet been implemented. The lack of progress in this respect is partly related to the choice of a gradual strategy. This gradual strategy has been appropriate and indeed necessary, but it is also risky and problematic. HISP in Mozambique has experienced some uncertainty regarding its status vis a vis MoH. Since HISP is presented as an incremental, bottom-up project that relies on 'cheap labor' (students), this implies that it lacks the legitimacy and backing of strong donors. This resembles the 'big is beautiful' dilemma, where a large and ambitious project was perceived as more attractive than a more modest and viable project (Ellingsen and Monteiro 2003). Consequently HISP has experienced a lack of top management support; there is espoused, but not realized support. The DHIS software was endorsed as the backbone for the "new" health information system in Mozambique by the MoH as early as 2001, but the much-awaited decision concerning ownership of the DHIS by MISAU has been delayed. The result of this decision would affect DHIS's sustainability, for example the MoH could play the role of the owner of the product and HISP could contribute with the technical support. However, HISP Mozambique can not only rely on political goodwill and wait for a full-scale and complete implementation. The project also needs to act to provide short-term benefits in order to not become marginalized. Currently, in an evaluation performed by an expatriate technical assistant the ambitions of DHIS were significantly curbed. HISP Mozambique has protested against this evaluation, as it further diverted support and induced hesitation from the Ministry of Health. The technical assistant involved with the evaluation used the temporary void in order for the Ministry of Health to consider the use of his own package, named Modulo Basico. HISP Mozambique fears that in this institutional arrangement the seeds for another legacy system are being planted, as the technical assistant may end his contract within months, possibly leaving with his know-how and source code. As another move to counter the threat of becoming marginalized, a GIS application (developed by an Indian HISP member) was linked to DHIS. This application allows visual representation based on the collected routine data, and can show maps with e.g. distribution of malaria cases, or coverage of district health centers. This kind of application is valuable for management,

and the introduction of this application was explicitly related to the need for increased top level support in order to not become marginalized.

In conclusion, we see that the gradual and stepwise strategy may be necessary, but not sufficient. Negotiations and contests emerge, and the project needs to engage with other actors beyond its sphere of control. This political nature is even more evident in the Indian case, to which we will now turn. Then we will return to Mozambique in order to discuss the various stakeholders associated with the multiple vertical programs.

4.2 The politics of integration

4.2.1 Integration as the forging of alliances

In section 2, we pointed out the way integration in IS predominantly has been conceptualized as a technical challenge, triggering technical means or mechanisms for integration. The case of HISP in Andhra Pradesh in India, vividly demonstrates the manner in which integration becomes embedded in deeply political processes of negotiation.

India's aid dependence is far less severe than the two African countries, and consequently local authorities tend to have more power. This is evident in the possibility to actually change the reporting format in Andhra Pradesh, and to create the Minimum Data Sets. Such a standardization process needs to happen as a joint bottom-up and top-down process. However, the significant role of donor influence is visible in the strong financial backing of the Family Health Information Monitoring System (FHMIS) project. The way HISP has needed to relate to this project is a poignant example of the political character of such processes (ICT for development). This implies navigation, ongoing and ad hoc improvisation.

The FHIMS project was funded by the World Bank and supported by the health bureaucracy in the state. This project was about to start within one district in Andhra Pradesh (Nelgonda) when the HISP activities commenced. HISP was perceived as a competitor by the health bureaucracy (commissioner for health and family welfare), and

the future of HISP in the state seemed threatened. Arguments were that the state did not want multiple systems, and that the forms had already been designed. Rather than challenging FHIMS, a strategy of compromise was followed, and it was proposed to integrate the DHIS software with the FHMIS system. The data (patient information) would be registered in the FHIMS, and an export file from the FHIMS would be converted to a text-file and imported into the DHIS, where facility-based analysis could be conducted. This was seen as relatively non-interfering with the FHMIS software. In addition, this solution was focused on data collection at the district level rather than the PHC where FHMIS was to take place. Along with this, a district level database was proposed for all the 23 districts, and the possibility to link these routine data to a recently developed GIS system was offered. As we write, this offer has been accepted by the state, and HISP is currently preparing implementation in two districts. The strategy in the two districts will be different; in one district the DHIS bridge will be employed at the district level only, in the other districts the DHIS bridge will be implemented in all 84 Primary Health Centers. The latter is a more costly approach, with regard to resources for training, persons involved and work load. It will, however, offer access to non-aggregated data, and can thus generate a more powerful analysis tool than a district level approach. The two approaches were deliberately different so as to gain experience and be able to select the most appropriate approach at later stages. Thus this strategy has been successful, and has provided HISP with an opportunity to 'ride on the back' of FHIMS during its expansion to the whole state (Braa et al., 2004). For example, HISP has taken advantage of the fact that as part of the FHIMS project all of the states around 1500 PHCs would be equipped with PCs and dial-up connection to the district servers; thus alleviating the need to spend scarce HISP funds on duplication of hardware.

However, the HISP team has taken care to not be too closely involved or implicated with the FHIMS as it is perceived to encounter serious problems already. The HISP strategy is explicitly opportunistic, as statements from the HISP India manager show:

"We do not want anything to do with the FHIMS software. There are no contractual agreement on updating and maintenance of the software between [the development

company] and the health authorities and we don't want to be left with that job. [...] We just want the plain text file from its report generator. We have designed the bridge so that when FHIMS die, we will just disconnect the bridge and live on" (HISP India project manager).

In India the role of political negotiations has been paramount. HISP has had to navigate in the rough waters of ever-changing political constellations. It has had to relate to both national and international actors. The expansion from the initial pilot district (Chittoor) to the Madnapally revenue was not initially planned, but occurred only because the political champion asked HISP to do it (Sahay and Walsham 2005). Political discontinuities following elections and related to the frequent transfer of bureaucrats, which is routinely done in order to curb chances of corruption, poses large challenges for a project like this, where skillful improvisation and navigation has been of paramount importance.

4.2.2 Striving for perfection

The problem of overlap and redundancy between Mozambique's many reporting systems is recognized at all levels of the health care sector. Despite the general agreement, actually attempting to integrate information systems from vertical programs is a complex and politically charged activity. The information systems are different in non-arbitrary ways, and these differences relate to their history, how they are shaped by the characteristics of the problems (disease) addressed, and how they are embedded into different institutional settings, both at local, national and international level. A study of the reporting practices of three major programs in Mozambique, the malaria, tuberculosis, and HIV/AIDS programs describes significant differences between the reporting systems (Chilundo and Aanestad 2005). The prevalence, incidence, mortality and morbidity of the diseases, but also the attitudes to the disease and the way treatment is organized shape the programs. For example, one of the major concerns in the treatment of tuberculosis is to avoid the emergence of drug resistant tuberculosis bacteria. Thus treatment is provided under a rigid regime involving close monitoring of drug administration to avoid a black market, and a patient-centered information system allows the program personnel to closely monitor the treatment progress for each individual. In contrast, the voluntary HIV

testing centers do not register personal information beyond demographic data like age, sex, etc. The main reason for this system is the social stigma attached to the HIV disease, as well as the fact that the centers do not offer any treatment opportunities. In that case, person-based information might be needed, e.g. in order to track potential other infected persons, e.g. sexual partners. So far, when treatment for HIV/AIDS has not been available, the incentive for testing has not been substantial. The policy has been geared more towards prevention, e.g. through information campaigns and condom distribution. In such a situation, the data needed (and recorded) are rather related to prevalence and changes in this. The situation is similar with regard to malaria, which in general is coped with (through traditional medicine, or with first-line drugs available at the black market), often without accessing health facilities.

The success of the tuberculosis program's approach may partly be explained by the fact that the program deals with few cases relative to other communicable diseases. The disease is not acute and the treatment program is long-term, and thus the reporting is performed only quarterly. The disease is well known and treatment strategies are well-established. Moreover, the program has strong financial backing, and is perceived as successful. It thus has a long-standing and strong institutional basis, which extends beyond the national borders. The infrastructure to deal with the HIV/AIDS pandemic is not equally well established. Compared to tuberculosis, HIV is a recent disease, and successful treatment strategies have not been generally available until recently, and treatment is still out of reach for most afflicted in the developing countries.

Differences are not just between the programs, but also between the actors involved (Chilundo and Aanestad 2005). While the overworked health worker gives little attention to data collection, information plays a crucial role for management. The Ministry of Health recognizes the problem of fragmentation and the ensuing sub-optimal functioning of the reporting and monitoring systems. To the Ministry, the activity of monitoring the effect of interventions and hopefully demonstrating progress is significant, as it is requested by both the donor community and the general public. In general, the donors' main interest is to ensure that their financial support is being well utilized and has

desirable impacts. Controlling and supporting programs that are disease-specific or limited in other ways will provide more effective means for this kind of control, while round-sum budget support may be intractable in terms of monitoring where the money goes. Some of the national aid organizations may be accountable to their home constituencies, from which there may be political demand on e.g. the mechanisms for control over the money flow to avoid corruption, or with regard to targeting towards needy groups etc. While concerns such as these may be a reason to sustain vertical programs, the donor community shares the concerns, and in Mozambique, the major donors cooperate towards integration. Ten of the major donor organizations pool their financial support into the Common Fund. However, this alignment does not cover all actors. The WHO has been met with criticism that their projects in general rarely are synchronized with the country's emerging processes aimed at developing their health systems. E.g. an evaluation of the Roll Back Malaria initiative found that the initiative was not linked up to sector-wide approaches, nor was it linked to the World Bank's poverty reduction strategies or its program of debt relief for heavily indebted poor countries (Yamey 2002). Apart from these donor organizations with a long-term involvement, other actors have recently appeared on the scene to combat the endemic diseases. One is "The Global Fund to Fight HIV/AIDS, Tuberculosis and Malaria" from the Bill Gates Foundation. Another major actor is The Bill Clinton Foundation working against the HIV/AIDS pandemic, and in particular targets low-cost medication to avoid mother-child-transmission. In general, such initiatives tend to establish separate control structures. However, some work is also going on in Mozambique to ensure that these private funds and the UN organizations are channeling their financial support through the Common Fund.

Consequently, the integration of information systems should not be perceived as primarily a technical issue, but rather as a complex and politically charged activity where multiple institutional influences and different, possibly competing, rationalities need to be aligned. The multiple reporting systems, the actors and their interests should serve as a poignant reminder of our message that seeking for just one order may be futile and even dysfunctional. Orders, or rationalities or logics are multiple, and this multiplicity cannot

be eliminated; it must be negotiated, lived with and handled in sensible ways. Lacking integration of IS, signaled by redundancies in data fields, functions or modules, regularly and understandably spawn efforts of tighter integration. However, in line with recent elaborations of ANT and the theory of information infrastructures (as elaborated on in section 2), there is a growing awareness about the unattainability – or even dysfunctional – nature of the visions of tight, seamless integration of large configurations of information systems. As Law (2003: 11) points out: “The argument is that entropy is chronic... Perfectionism would be dangerous”.

5. CONCLUSION

Establishing working information systems in developing countries is truly a challenge. The abundance of documented partial and complete failures within the domain of health care as well as in other domains demonstrates this beyond any reasonable doubt (cf. section 2 above). This might (implicitly) suggest that experiences, lessons and insights from information systems processes in developing countries are too specific or unique to allow for translations into a Western setting. This, we believe, is a serious misconception. The situated or ‘sticky’ nature of experiences is a general trait, identified e.g. within knowledge management and not something only applicable to developing countries (Orlikowski 2002). The exact configuration of the context for an implementation, e.g. the company, timing, history, business environment, political milieu, is always unique. Interpretative information systems research should be able to pull out, i.e. to translate and appropriate, selected aspects to make them more generally applicable. To dismiss of experiences from developing countries as not applicable to the West is politically arrogant and intellectually naïve as critiques of post-colonial reason teach us (Spivak 1999; Mignolo 2000). Moreover, the challenges we discuss related to historicity and heterogeneity are pressing problems also in Western business organizations.

Our analysis has revolved around the two core themes of historicity and heterogeneity of information systems. We argue that a generalized strategy for large, infrastructural information systems development needs to incorporate both these themes.

Firstly, the historicity of information systems development highlights the historical sediments of legacy systems, of institutionalized, even ritualized routines, of deep-seated perceptions and sentiments. This entails a stronger focus on cultivation, i.e. on evolutionary, small-step changes both in the (so-called) social and technical (Orlikowski 1996; Dahlbom and Jahnert, 1993; Aanestad, 2002). Analytically, we may here draw on theoretical studies that underscore the continuous and non-abrupt changes and how

“[it] is not an immutable but changeable object...experimenting and changing are still going on...[it] is fluid because it is variable over time” (de Laet and Mol, 2000:228).

Secondly, we want to emphasize the heterogeneity of information system, the existence of many non- or poorly integrated systems, fragmentation and the perceived ‘mess’. With respect to these challenges we in particular want to draw attention to research that underscore the un-attainability of ever reaching a state of tight, seamless integration:

“[T]here are always matters out of control. Diversity. Diverse and incomplete centres. Unstable relations. This is a chronic state of being. It is an argument about imperfection. About its unavoidability. To make perfection in one place...would be to risk much greater imperfection in other locations.” (Law 2000, pp. 10-11).

The clear, admittedly controversial, implication for large-scale information systems development is that is better to let go of the idealized visions altogether and confront and live with the mess:

“[E]ntropy is chronic... Some parts of the system will dissolve. In which case the art of management is that of accepting some failures but wisely choosing which to try to put right. For a manager accepting perfection is not a failing. It is an advantage. Indeed a necessity. Perfectionism would be dangerous” (ibid.: 11).

Integration is not the quick fix it is promoted as. The core challenge, thus, is not to strive for the (unattainable and dysfunctional) ideal of completion, perfection and seamless integration, but to live with a ‘reasonable’ level of mess.

List of abbreviations

NGO – Non-Governmental Organization

HISP – Health Information Systems Program

STD – Sexually Transmitted Diseases

FHMIS – Family Health Management Information System

BES – Boletim Epidemiológico Semanal (Weekly Epidemiological Bulletin)

TB - Tuberculosis

MTUHA - Mfumo wa Taarifa za Uendeshaji Huduma Za Afya

GIS – Geographical Information System

GNI – Gross National Index

ANT – Actor Network Theory

SIS – Sistema de Informação para a Saúde

SIMP – Sistema Integrado de Monitoria e Planificação

SPSS - Statistical Package for the Social Sciences

ERP – Enterprise Resource Planning

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