Implementing a health information system in India: Challenges and opportunities for scaling and sustainability

Master thesis

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Abstract

Health Information Systems (HIS) are used to collect and analyze health data in order to support the improvement of health care services. Public health care in third world countries are often based on a poor functioning HIS. Simply put, data collection processes tend to be extensive, often of poor quality and typically failing to be used for practical purposes such as for effectively allocating resources. Thus, exploring ways of improving existing HIS is evidently a fruitful approach to strengthen public health care. As a part of health sector reform, governments in many developing countries are in the process of strengthening their HIS through the introduction of computer based systems.

This thesis describes and discusses the implementation of the Health Information System Program (HISP) in the Indian state of Andhra Pradesh. The study was done using an action research approach over a five month period spread over two years. The challenges were to work with political, infrastructural, human resources, geographical, and cultural issues to get the system developed, implemented and institutionalized. The results show that to institutionalize a HIS into the everyday working of the health department in Andhra Pradesh, it is important to recognise the interdependency between scaling and sustainability. Scaling indicates the need for the HIS to reach a certain geographic and functional scope so as to become of interest to the higher levels. Small pilot projects have problems in reaching such scale, and will therefore end up more as interesting academic exercises, unless they manage to reach a certain scope and scale.

Theoretically, concepts from information infrastructure theory have been used to better analyze the complexities of scaling and sustainability, and their interdependencies. An important research focus has been to explore how the smaller scale project in India that was studied could be extended – scaled up – so as to become of interest to health managers at different levels, and thereby, eventually, become institutionalised. Three key processes have been identified to achieve this goal of institutionalization. These are the processes of cultivation, the creation of gateways to enable integration between the “installed base” and the “new system”, and the choice relating to the level at which data-entry and report generation should take place. To achieve institutionalization, in addition to the above focus on these processes, equal emphasis needs to be also placed on obtaining political support, thus emphasizing the need to combine top-down and bottom-up strategies.
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Oslo, 12 February 2007

*Parken forever!*
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Glossary of acronyms used

ANT – Actor Network Theory
CMC – Computer Maintenance Corporation; an IT company part of Tata
DHIS – District Health Information System
FHIMS – Family Health Information Management System
GIS – Graphical Information System
HII – Health Information Infrastructure
HIS – Health Information System
HISP – Health Information System Program
HMIS – Health Management Information System
ICT – Information Communication Technology
II – Information Infrastructure
IS – Information System
NGO – Non-governmental organization
PHC – Primary Health Centre
SC – Sub-Centre
UN – United Nations
WHO – World Health Organization
1 Introduction

This thesis is about analyzing the implementation of a health management information system in a rural and poorly developed state in India. This state (Andhra Pradesh) is however currently making significant strides in adopting information and communication technologies (ICT) as an explicit tool to support the strategy of e-governance and poverty reduction. Most of the thesis is based on fieldwork from Kuppam, a small town in the state of Andhra Pradesh in southern India, performed over three periods between January 2002 and May 2003. The thesis examines the challenges and opportunities of implementing the health information management system in Andhra Pradesh, with a focus on two key topics of scaling up the information system introduced from the pilot site to the whole state, and of sustainability which implies that these systems become institutionalized into the everyday working of the health department.

Most of the empirical data in this thesis is based on the implementation of the Health Information System Programme, popularly known as HISP – a health management information system that offers open source software founded on the principles of evolutionary systems development, action research and participatory design within the context of implementation and use. HISP started in South Africa since the advent of democracy in 1994, and has today evolved into an extensive research and development network containing a handful of countries with main hubs in South Africa and Norway. Within this global network, for the first time, software is exported from South Africa to India, creating a “south-south transfer” of software.

1.1 The problem of the digital divide

According to the United Nations, the digital gap between rich and poor countries continues to increase (UNDP 2003), and one main reason is the digital expansion of the rich countries. The UN has requested the technology industry to cooperate with national authorities, both professional and industrial bodies, to find new and improved ways to integrate developing countries into globalization processes. At the UN Information and Communication Technology Development Congress in June 2002, participants were in general consensus that ICTs are increasingly playing a major part in stimulating economic growth and expansion in many countries. But there is the real danger that poorer nations, because of historical and geographical reasons, will be left behind. Thus,
they will be further marginalized because of inadequate access to ICTs, and poor capacity to use it. This danger, popularly known as the “digital divide”, has been recognized by both the World Bank and the International Monetary Fund (IMF), who seek to bridge the gap of the digital divide as part of their future policy relative to the fight against poverty and diseases.

Despite India being well known for its contribution to the global IT industry, only limited attempts have been made towards ICTs to address the problem of more than 75 percent of the population that live in the rural areas, for example related to health and education. Applications that can benefit the rural population for example in health and education, and at the same time reduce the flow of people to the cities could potentially help to decrease the digital divide between the urban and rural population in India, a problem that is as significant as the divide between the developed and developing countries.

Globalization, which relate to issues such as technology transfer, increasing interconnectedness of different societies, human resource development and marginalization (Braa et al. 2002; Walsham 2002), provides both the potential to reduce the divide, and also increasing the same. It is often argued that this new “globalized” world is primarily driven by Western models of development, enforcing objectives and technology into developing areas without taking the context seriously into consideration. Many scholars have emphasised that systems development approaches in developing countries have failed to consider context, and as a result projects tend to fail (Braa 1997; Walsham 2001). The digital divide problem (for example poor infrastructure and human resource capacity) can be seen to contribute to these failures, and also gets magnified as a consequence of it. However, sensitively designed and implemented information systems can provide the potential opportunity to reduce this divide. This thesis attempts to analyse such challenges and opportunities in the context of deploying health information systems for supporting health care in rural India.

The introduction of a health information system in third world countries that aim to support deprived and local communities is a complex task (Mosse and Sahay 2003). Contributing to this complexity is what we term as the interconnected problems of “scalability” and “sustainability”. Pilot projects in third world countries are often initiated through limited funding and scale and in selected settings which do not have the capacity to support the larger system of health care. Also, typically when the aid dries up and experts leave, the systems are no longer sustainable and they slowly fade away and die. The narrow focus of scale and sustainability has resulted in many ineffective efforts to implement health information system. This thesis seeks to understand the nature of this problem of scale and sustainability, and analyse what can be done to address them.
1.2 Problems addressed

The thesis aims to analyze the challenges of system development and implementation within the primary health care domain in a rural setting, and to look at the opportunities to improve the health management information system in Andhra Pradesh. These challenges and opportunities are examined in the context of the problem of scaling and sustainability outlined above. Both a micro and a macro perspective are required to analyze these problems. The size of the state, with a population of over 75 million and over 1200 primary health centres requires a perspective that is concerned with how micro level experience and learning can be translated to the state, and also how these can be continuous over the long term.

Most of my fieldwork was carried out in Kuppam, a small constituency in Chittoor district situated south in the state of Andhra Pradesh. Kuppam is a community with a population of about 320,000 people and has been known for being one of the poorest and most remote towns in Andhra Pradesh. However, in recent years the constituency has become a test area for technology based socio-economic development and e-governance initiatives. This micro level research in Kuppam was integrated with analysis in the state capital of Hyderabad in order to get the more macro perspectives to the problems of scale and sustainability. This fieldwork was aimed at addressing the key research question elaborated below.

1.2.1 Research question

The research question that this thesis seeks to address is: “What are the challenges and opportunities for designing and implementing HISP in Kuppam that can be scaled to the state level and is sustainable over time?”

An action-research approach was adapted to address this question and, empirical research was conducted over a five months period in 2002 spread over two phases of four and one month each. In addition a two week trip was made to the research site in May 2003.

1.2.2 Objectives

The above research question translates into four key objectives:

1. Analyse ongoing problems and opportunities while engaging with system development and implementation in Kuppam,

2. Demonstrate benefits of the HISP approach in Kuppam with respect to data analysis and methods adopted,

3. Analyze state level issues in scaling up the system and attempting to engage with them at both the technical and political levels,
4. Reflect on strategies to make HIS scalable and sustainable.

1.3 Motivation

I was introduced to the HISP project by professors from the University of Oslo. The somewhat alternative approach of doing research in informatics with a global focus and the ideology of working with health related issues in a developing country inspired me to join this small and idealistic group of health information researchers. The work this group does, pushing towards a better health information system in Andhra Pradesh, will ultimately improve the health of the people and address some of the issues of marginalization.

The ability to travel and doing research within the Indian culture has broadened my views on a professional level and perhaps even more at a personal level.

1.4 Road map of the thesis

After this introductory chapter, chapter 2 gives a general introduction to HIS in developing countries, describing the challenges and opportunities within the domain of IT and health systems. In addition the chapter reviews theoretical considerations in computer science, sociology and information systems research that are relevant to my research. Next a description on the research approach is given in chapter 3, elaborating on the methods and ways of working to gather empirical data.

In chapter 4 I introduce the empirical work by describing the background of HIS, with a focus on scale and sustainability of HIS in various developing countries. Chapter 5 gives an overview of Andhra Pradesh and Kuppam with a description of the health information system and the various IT initiatives in these two places. A rich description of the fieldwork conducted in Kuppam is given in chapter 6, unfolding processes of standards, information flow, experiences from implementing and conducting training. Chapter 7 presents an analysis of the health data collected with HIS, which helps to illuminate the benefits of the HIS approach as a specific mechanism of an action research intervention. Chapter 8 provides an analysis and discussion of the key findings with a focus on scaling and sustainability. Some final reflections are provided in the last chapter.
This chapter introduces and outlines the challenges and opportunities related to developing and implementing HISs in developing countries. First, I argue that implementation of HISs must be seen in a global perspective in order to get a clearer understanding of the complexities involved. Second, I review key theoretical considerations that are relevant to analyze, develop and implement HIS in developing countries within a global context. Third, I briefly discuss implementation challenges related to scale and sustainability. The last section gives a summary of my theoretical perspective.

Public health officials in developing countries have a range of different tasks they need to consider to serve the health needs of the community. They need to: Identify priority health problems; formulate effective health policies; respond to public health emergencies; select, implement, and evaluate cost-effective interventions to prevent and control diseases and injuries; and allocate human and financial resources. In addition to these community related health issues, the struggle is to fight global health issues such as HIV/AIDS, malaria, infant and maternal deaths, and tuberculosis. These are matters of global concern and dominate international debates like the AIDS summit in Paris 2003 where Nelson Mandela urged to strengthen the global fight against HIV/AIDS. To fight these challenges, international agencies (like the World Health Organization, the World Bank and IMF) and government authorities need to know where to best allocate resources and funds to improve the health of the people. For example, the increasing focus on fighting the HIV/AIDS epidemic in developing countries, from both philanthropists (e.g. The Bill and Melinda Gates Foundation) and national governments, has recognised the value of HIS to monitor such vertical programmes (WHO 2003). It is increasingly being recognized that HIS can significantly contribute to help address health service delivery problems (Braa et al. 2004), especially if all the vertical programmes are integrated (Braa et al. 2007).

Through the Alma Ata declaration, the World Health Organization (WHO) declared a global vision for developing countries of access and equity and health services "for all by 2000" (WHO 1979). The need for more rational allocation of resources and setting of priorities have lately made HISs play a major role in achieving this goal (Lippeveld et al. 2000).
information system to ensure decentralized management and coordination of
the health services is advocated as the appropriate level for HIS development
(WHO 1994; Lippeveld et al. 2000). However, achieving this vision has been
difficult in practice because of the intrinsically centralized and fragmented
character of health services, lack of coordination, poor quality and use of in-
formation, and the complex organizational context of the health sector
(Avgerou and Walsham 2000). As a result, HIS projects have not achieved de-
sired results (Braa and Hedberg 2002), a trend quite similar to the use of ISs
more generally in developing countries (Sahay et al. 2000; Krishna and Madon
2001).

Thus, developing and implementing HISs in developing countries must be
seen from a global point of view. One cannot analyze the failure of HIS in de-
veloping countries without taking the larger context into consideration, and
the relation of the implementation efforts to that of funds, expertise, and trans-
fer of technologies from different countries.

The topic of globalization and marginalization, and more specifically the prob-
lem of the digital divide is highly relevant within the Indian context. For ex-
ample, does common citizens in India, as a major software exporter, benefit
from ICT? Or, on the contrary, are many of the 700 million people living in
rural areas being further marginalized because an increasing digital divide be-
tween rural and urban people? The introduction of a health information system
in rural India is one way of trying to decrease this divide, at least potentially.

2.1 Globalization, marginalization and ICTs

Globalization is one of the most talked about phenomenon since the late eight-
ies, and has today perhaps become even more relevant post September 11.
Globalization has today extended from the economic sphere into cultural, hu-
man right, military and information technology issues (Eriksen 2000). There
are thus many different viewpoints associated with globalization. A general
view is put forward by Hall et al. (1992):

“A process which cuts across national boundaries, integrating and
connecting communities in new space-time combinations”

Giddens (1991) offers a sociological viewpoint on the phenomenon:

“The intensification of the world-wide social relations which link
distant localities in such a way that the local happenings are shaped
by events occurring many miles away and vice-versa”

A third and primarily economic viewpoint is formulated by Castells and Hen-
derson (1987):
“A process which highlights the trend towards freer trade, and the flow of finance, labour, data and commodities among countries … a techno-economic restructuring process that is taking place in many parts of the globe … is redefining capital-labour relationships and the role of the state”

Although these perspectives differ in emphasize, there are however similarities across the academic disciplines on viewing globalization as a process that transcends national boundaries, connects communities across varying time and space conditions, involves (easier) flow of people, goods, services and technology, and it usually involves multinational corporations. Information technology is seen as playing a central role in enabling this process (Sahay 2000). Issues of health and health information are deeply implicated in contemporary globalization processes, some of which will now be discussed.

2.1.1 Health information and globalization

Globalization is often known and criticized for being a one-way process, flowing from Western to developing countries. Castells (1996) points out that many regions and sectors of the world have been excluded from globalization processes in the past because of historical and geographical reasons. The fear is that these regions and sectors will continue to be left out and thus further marginalized because of inadequate access to ICT and knowledge. The gap, between the marginalized and those who benefit from increased access to ICT because of globalization, is what is popularly called the digital divide (see e.g. Fink and Kenn 2003). Appropriate design and use of HISs for the marginalized, and strategies to spread this technology world-wide, may be one possible way to counteract the rapidly intensifying process of marginalization. In contrast to this view, other authors argue that information technology may then increase this divide for a variety of historical, political and economic reasons. An underlying argument is that the technology is made by Western countries for Western countries and that developing countries cannot use this technology to its full potential, and thus will always be playing “catch-up” (Heeks 2002).

However, despite the disagreements over the nature of the divide, it generally serves to emphasize that the world has many global health related problems to handle. The AIDS conference in Paris, hosting among others Mr. Nelson Mandela, concluded that the HIV/AIDS decease is the root to many of developing countries’ problems and that this issue must be dealt with internationally. Another example is the former US Secretary of State Collin Powel explaining in a BBC interview, that the United States contributes to the HIV/AIDS crisis as a way of dealing with the “war on terror” globally.

Sen (2000) emphasizes the link between health care and poverty. Based on an inter-country comparison, he concludes that there is a general relationship be-
between life expectancy and GNP. This relationship is based on the income (specifically of the poor) and public expenditure particularly on health care. As a result, he writes, “the connection (between health care and poverty) tends to work particularly through public expenditure on health care, and through the success of poverty removal. The basic point is that the impact of economic growth depends much on how the fruits of economic growth are used” (p 44). Sen further argues for the informational basis of this connection between health care and poverty, especially the informational distortions that can occur. The ineffective reporting on health needs, health status, and on health services actually contributes to poorer health services because of less transparency and reduced opportunities for executing political and social pressure on authorities to address these problems. Within the context of health information systems, better health information can help to strengthen the health care system. And as a result of this, improved health care can ultimately address poverty reduction issues with a focus on more public expenditure on health, and the improvement of HISs.

The global issues need to be exclusively linked with local concerns, such as the development and use of HIS. Health information managers need reliable and relevant data to effectively decide on allocation of resources and improve the quality of health services. The “health for all” global strategy of WHO needs a decentralized health system which raises the need for introduction at local level with increased skills to handle information at the local level. In marginalized communities with poor infrastructure (like roads, computers, telephone lines etc.) there is a poor culture to deal with information in a systematic way, and also the political and institutional structures are resistant to change (Sahay and Walsham 1996). A challenge is then to build up “counter-networks” (Mosse and Sahay 2003) within these communities based on information, knowledge and ICTs to strengthen local health management by making visible the health problem of the poor to broader networks, and use this possibility to advocate for increased and more focused resources and interaction.

2.2 Information systems and Health Information Systems

Sommerville defines a information system as “a purposeful collection of interrelated components that work together to achieve some objective”, which involves people, technology and the system environment (2001, p 21). An information system is developed and maintained to support, manage and define processes of collection, aggregation, use and flow of information. Similar to Sommerville, Heeks also defines information systems as
“…systems of human and technical components that accept, store, output and transmit information. They may be based on any combination of human endeavours, paper-based and IT”

(Heeks 1998, p 5)

Braa and Nermunkh (1997) argue that as the actions and dynamics within an IS most often are primarily based on technology and use of computers, and introducing ISs in developing countries is more complex as compared to that in developed countries. Hence, the focus when approaching an IS should be on the people within the context and processes of technological learning, and not primarily on the technological elements of the IS (Braa and Hedberg 2000).

In order to better address this complexity, researchers have argued for alternative conceptualizations of IS. Instead of emphasizing primarily as technological artifacts, IS may be seen as social systems or information infrastructures. For example, Walsham (2001) argues that large ISs should be understood as social systems made up of a web of social and technical elements. ISs are a part of the social context that needs to be understood with respect to relationships and dynamics within the organization, and the infrastructure supporting them, in Walsham’s words:

“The technical and the social must be considered together, and in specific contexts, in order to investigate the role of technology in work and organizations”

(Walsham 2001, p 44)

Another approach to the study of ISs as social systems comes from the conceptualization of IS as web models. Kling and Scacchi (1982) introduce the concept of web models for understanding the connection of large ISs and its social and political context. Several authors have defined ISs as web models, which are used to provide theoretical frameworks to understand and analyze the social context through a web of associations around the IS (Braa and Nermunkh 1997). ISs are regarded as complex social objects as embedded in a social context. This view, it is argued, is in contrast to the traditional discrete-entity perspective on organisations and ISs, which focus on primarily technological features.

Actor Network Theory (ANT) builds upon the socio-technical conceptualizations of IS, and has been used by many IS researchers to study ISs at a micro-level. ANT is born from the original work at Ecole des Mines by Callon (1986) and Latour (1987) which had its roots in the domain of sociology of science, and subsequently included a stronger focus on technology, and information technology (Latour 1996). The principle idea of ANT is a fairly simple one: It seeks to examine a network of actors (human and non-human) and how these actors are linked together, thus creating a heterogeneous network of aligned
interests. For example, when driving a car, you are influenced by traffic regulations, previous driving experience, and the car’s manoeuvrability. All of these factors are related or connected to how you act, and so should be considered together. An actor network, then, is the act linked together with all of its influencing factors (which again is linked), producing a network (Ciborrah et al., 2000, p. 75). A major focus of ANT, when applied in particular contexts, is to “try to trace and explain the processes whereby relatively stable networks of aligned interests are created and maintained, or alternatively to examine why such networks fail to establish themselves” (Walsham and Sahay 1999, p. 42).

Translations and inscriptions are two important concepts of ANT. Translations describe how interests are aligned in the actor-network, while inscriptions describe how viewpoints and intentions of behaviour are embedded in the actor-network.

A wide range of IS researchers have used ANT to carry out interpretive studies on the role of information technology. Monteiro and Hanseth (1995) use ANT in two contrasting cases to describe how translation and inscriptions take place in creating EDI (Electronics Data Interchange) systems within the Norwegian health sector. The two examples described are the exchange of drug prescriptions and laboratory orders and results. They particularly study the “social constructions of standards” and how these standards are embedded into the “information infrastructure”, and use ANT “to describe important and neglected aspects of information infrastructures” (p. 327). In another example, Braa and Hedberg (2000) emphasize the usefulness in using ANT to analyse the process of developing a HIS in post-apartheid South Africa. They focus on Walsham et al.’s (1990) perspective on seeing ISs and social systems and thus actors and actor-networks of all kinds are considered in the process of analyzing standards and large-scale complex ISs.

A further development to the conceptualization of ISs as social systems comes from Hanseth’s discussion on information infrastructures. He describes information infrastructure as complex social webs of ISs, including humans, social and technical components, that develop and grow over a long time, layers upon and within each other (see, e.g., Hanseth 1996). Hanseth (2000) sees information infrastructures as something more than pure technology, and argues for seeing infrastructures as socio-technical networks that are connected and interrelated. Infrastructures have aspects such as being enabling, shared and open; they must support a wide range of activities and must be used by a large community. The openness tells us that there should be no limit in human or technical actors involved within the infrastructure. ‘Installed base’ is a term used to describe one key aspect of infrastructures. ‘New’ infrastructures are never developed from scratch, they are always integrated into or replace only parts of an already existing infrastructure, referred to as the installed base (Hanseth 2000, p. 60). Thus, changes to an infrastructure need to be done incrementally and
over time. Other important terms within information infrastructure terminology are 'lock-in effects', network externalities and gateways. Lock-in occurs when one technology is so dominant that it becomes very hard or impossible to develop competing technologies; the dominant choice becomes locked-in regardless of the advantages and alternatives (Hanseth 2000, p. 65-67). Using ANT terminology, lock-in effects can essentially be conceptualized as an irreversible installed base. Callon (1991, p. 159) states that an actor-network may turn irreversible depending on 1) the extent to which it is subsequently impossible to go back to a point where that translation was only one among many, and 2) the extent to which it shapes and determines subsequent translations. Network externalities tell us that, all other things being equal, it is better to be part of a larger network than a smaller one (Shapiro and Varian 1999; Hanseth 2000, p. 64). The term ‘gateway’ is used to describe a strategy to link old and new networks as a fast evolutionary approach, as opposed to backward compatibility (Hanseth 2000, p. 69-70). The difficulty in developing and installing gateways depends on the incompatibility between the two infrastructures.

Hanseth and Monteiro (2004) stress the importance of interdependency between standardization and flexibility in information infrastructures. They argue that information infrastructures are driven by standards, and how these standards are resistant to change in a socio-technical network. By changing one standard to be more attractive, other standards need to change too, and to do this without creating lock-ins, standards need to be flexible enough to handle the change. The difficulty of creating flexible standards is in the nature of how standards and the installed base changes, which is illustrated as the standards reinforcing mechanism in figure 2-1. Hanseth (2000) argues that standards need to change to attract more complementary products, which again gives greater credibility of the standard. Together these make the standard more attractive to the user of the infrastructure. Further adoptions are then made, leading to a larger installed base. This reinforcing mechanism can lead to lock-in effects if standards are not flexible to handle the changes needed to be an effective infrastructure.

![Figure 2-1: Standards reinforcements mechanism. Source: Grindley (1995)](image-url)
2.2.1 Conceptualizing HIS as HII

Both these conceptualizations (ANT and information infrastructure) argue for ISs being seen as heterogeneous and complex networks. They are thus helpful and complementary in the analysis of HIS in developing countries that in particular embrace political, cultural, and technical issues. Because HIS in developing countries have special characteristics that distinguish it from other ISs, it makes sense to conceptualize them as a health information infrastructure (HII). IS design methodologies aim at developing a closed system by a closed project organization for a closed customer organization within a closed time frame (Hanseth and Monteiro 2004). These limits do not fit the global view of HIS, which needs to be open, dynamic and flexible to change. The concepts of lock-in, installed base, standards, and cultivation, are particularly relevant to understand HIS as HII, and are now discussed.

Existing HISs in many developing countries, for example Cuba, India, and Mozambique use complex and rigid (often paper-based) methods for collecting health data. Typically when trying to change such existing systems, the installed base and lock-in effects can be analyzed in relation to how existing standards are subject to change or not, and how networks transform. A changeover, for example from a paper-based to computer-based information systems that requires deep organizational changes, can be analyzed using ANT and information infrastructure terminology. Skobba (2003) writes about the difficulties of changing existing legacy systems in Mozambique, especially how systems were unable to communicate with each other because of technical and organizational reasons. On the one hand, donors for various systems had withdrawn and no source code was available, thus making changes to the databases impossible. On the other hand, various systems were on different platforms (e.g. MS DOS and Windows), making gateways between the systems difficult to establish. Because of these difficulties, the systems continue to be used independently and in a fragmented way, and consequently the installed base presents a “locked-in” state.

Hanseth (2004) argues that having open and flexible standards are a perquisite for scaling information infrastructures. This brute force argument tends to make the problem concerning in what standards are to be used by who, how should they change as needs change, and how should standards relate to each other. Monteiro (1998) uses the revision of the IP protocol to exemplify the difficulties of scaling the Internet. The problem of scaling the information infrastructure (the Internet) lies in the “institutionalized practice of pragmatically and fairly pluralistically negotiating design issues” versus the “increasing pressure from new users, interest groups, commercial actors and industrial consortia” (p. 243). Creating a transition of standards from the one installed base to the next that can address these socio-technical issues is the main challenge in scaling the Internet.
When developing HISs, a number of systems development related problems arises. For example, formulating explicit requirements specifications at an early stage, and dealing with the changes of these specifications later, are major challenges when trying to create an effective and high-quality HIS. Systems development research has proposed alternative ways of approaching the problem of the changing of “frozen” specifications by using alternative development processes. Thus, the strategy on how to develop and implement a new HIS must be carefully considered. By using the framework of HII, it is possible to better analyze the basis on which such considerations are taken, and more importantly why HISs work or fail. One way to apply the social systems perspective of HII in system development practice is the evolutionary approach. This approach, as opposed to the waterfall approach (Sommerville 2001), is especially relevant when domain understanding of the problem is low. The process is done in a number of cyclical events, involving especially the users to improve the initial implementation in each cycle. Thus, the increased user involvement in an evolutionary setting potentially helps developers to build a better understanding of the requirements. However, evolutionary development is better suited for small systems when complexity is low and uncertainty is high (Sommerville 2001), raising the need for additional methods to be used. Prototyping is one method that can be seen as being complementary to the evolutionary approach (Budde et al. 1992). This method can be implemented in several ways, but it basically involves the creation of a prototype that is used as a basis for further development. Braa and Hedberg (2000) describe how prototyping in South Africa was based on an improvisation strategy because of the nature of the political and administrative structure. This informal methodology, as opposed to the more rigid and formal waterfall kind of approach, resulted in the users having increased access to the development of the system, and with it more commitment.

Braa and Hedberg’s (2000) prototyping approach was based on the “Scandinavian approach” of participatory system design. The Scandinavian approach evolved from the “Iron and metal project” as described by Nygaard (1979). This work-oriented design approach, focus strongly on democracy and action-oriented research by involving parts on all levels within an organization (Ehn 1993). Two important aspects of participation within the Scandinavian approach is, one, the skilled users, can contribute importantly to successful design, and two, the political feature, which raises questions of democracy, power and control at the workplace. Lyytinen and Livari (1998) characterise the Scandinavian approach as a “grass root” approach because it tends to focus on small scale development of individual application systems, instead of the total IS.

Building on the evolutionary approach and participation, the notion cultivation is used to describe how IS can be scaled through local commitment and ownership. Braa (1997) argues that a bottom-up, participatory design process is cru-
cial in creating such local commitment and ownership. The challenge however, is thus how you spread replicable processes and to cultivate them locally. Hanseth (2004) argues that the self-reinforcing process provides a mechanism for one way of cultivation. The installed base is seen as a living organism that cultivates and has its own materiality, rather than some passive material to be designed as the designer pleases.

The concepts of installed base, lock-in, standards and cultivation are thus all important in understanding and analyzing HII in developing countries. Large scale HII cannot be analyzed and implemented using ordinary systems development principles because they do not consider HII in all its complexity arising from the multiple levels, its dynamic nature, and the involvement of multiple user groups and needs. The conceptualization of HIS as HII is the basis for my theoretical perspective, based on concepts of installed base, lock-in, and cultivation, and as argued they help to better understand the challenges of scale and sustainability.

2.3 Implementation challenges: Issues of scale and sustainability

There have been many attempts to introduce HIS in developing countries, but most efforts have not been successful; “the task of health information system reform is both formidable and complex, particularly in the context of government bureaucracies and developing countries. Failures tend to be more common than successes.” (Lippeveld et al. 2000, p. 225). The issue of scale and sustainability are important challenges to address while planning for the implementation of HIS. Sustainability of the HIS is a natural factor to consider because of the resources put into the system, and also because of the expectations it raises for the deprived who ultimately seek to be benefited by the system. The scale of a HISs is also important because it must be of value for health managers and decision-makers. There is a need to scale from small scale systems, which do not adequately provide a “view” of the complete health status of a region. A wide picture is required to make relevant decisions. A scalable system is thus an essential condition for success.

Reynolds and Stianson (1993) describe sustainability as maintaining something that already has existed over time or is equated with ‘self-sustaining’ and ‘self-sufficient’, meaning that no outside support is needed. However, in information system practice, ‘sustainability’ can mean the ability to identify and manage the risks threatening the long-term viability of the information system project (Korpela et al. 1998). Sustainability is therefore considered from the birth of the system, and the processes once external support is pulled out (Braa et al. 2004).
Braa et al. (2004) describe *scalability* as the problem of making a working system solution, that can be spread out to other sites and successfully adapted there. This spread relates to both technical issues of scalability, as well as the reproduction and translation of learning processes alongside the spreading of artefacts, funding and people. Braa and Hedberg (2000) describe the difficulties of implementing a health information system in South Africa were one of the major obstacles relates to the scale of the project; it was not possible to implement the system in small independent areas when the rest of the county had other ways of collecting and using the health data. The problem is analyzed through the concept of standardization – how a national hierarchy of flexible standards can be adopted to empower managers at local level.

Anja et al. (2000) mention constraints like the lack of modern and adequate information and communication technology and skilled personnel, low income and morale, and cultural differences as reasons for a poor functioning health information system. Because of the degree of these constraints, the risk of failure of HISs in developing countries is very high, making sustainability a major challenge. In the following paragraphs I will thus review key domain challenges influencing the problems of scale and sustainability. The issues are analyzed under the topics of: 1) Political challenges, 2) Donor related challenges, 3) Infrastructure related challenges, 4) Human resource related challenges, and 5) Other cultural challenges. These challenges are briefly elaborated on below.

**Political challenges**

The political challenges that HIS reforms often experienced in developing countries are embedded in how governments are run. The democratic pillar of “the people electing a government” is a firm and solid tradition – however, a dilemma is that it may result in instable governments that only pursue short term goals. Democratically elected governments often do initiate bold long term reforms, which are either cancelled or changed significantly to reflect the agendas of the new elected government. For example, Braa et al. (2004) mention how the HISP project is affected by political instability because of the way HISP is supported politically. Because of such instabilities, HIS reforms that typically require five to ten years before results can be made visible to the voters are often subject to frequent change, adversely influencing the sustainability of the system. Since often projects live and die as “pilot projects“, they can never be scaled up to a level where they become useful to manager for dealing with operational decisions, for example how to allocate limited available drugs amongst all the clinics in a area.

**Donor related challenges**

Typically, information system projects in developing countries are funded by international aid agencies. Funding is often short term and the projects are soon left in the hands of local beneficiaries. The local organization capacities
withers away after the withdrawal of donor financial and technical support (Heeks and Baark 1998). The short term funding often result in a lack of transfer of expertise and knowledge, and thus local beneficiaries are neither in a position to scale nor keep the system sustainable when the system is not institutionalized.

One can also question the way donor funding is spent. Millions of dollars are often wasted in developing countries where organizations such as the WHO, IMF and World Bank sponsor short-term HIS reforms efforts. These programmes are often implemented at a large scale, but fail because they tend to focus too much on the technology as the driving force of the reform. This technological determinism makes the systems unsustainable and the end result is often of no value when the funding is over. Puri (2003) summarizes how donors historically have continued to support techno-economic development projects that fail, and how this has led to the demand for alternative development models that can influence the success of the projects, and consequently the sustainability of the development projects. Increasing community based participation in the design and implementation of these programmes is a crucial element of these alternative models.

**Infrastructure related challenges**

The infrastructure in developing countries is of poor quality compared to developed countries and this puts several preconditions on how HIS are implemented especially in rural areas. Communication technologies, like the telephone, mobile networks, broadband, wireless networks etc, are either not available or the extent of these technologies is limited; roads and public transportation are often very limited or of poor condition in rural areas; and access to electricity can also be inadequate in various rural areas, which again influence the availability and use of communication technologies (Walsham et al. 1988). In addition, investments in ICT may be seen as an unaffordable luxury when faced with problems such as high illiteracy and shortage of basic needs (Bhantnagar 1992). For example, Mosse and Sahay (2003) describe how the relation between the constraints of communication and physical infrastructure of roads contribute to the limited use of HIS in Mozambique. Another example is the lack of logistics relating to ICT needs; when for instance a computer peripheral becomes faulty it may take days to get a replacement. These infrastructural disadvantages impede health information reforms in time and resources. Scaling the reform/system and making it more sustainable gets harder as distances become greater, and as a consequence, more communication and travel are needed.

**Human resources**

The United Nations Millennium Development Goals (UN 2004) emphasizes the lack of educated people in rural areas in developing countries, and empha-
sizes education as a way of reducing poverty and building a viable workforce that is able to compete within an increasingly competitive and global economy. The shortage of skilled, experienced and adequate human capacities, for instance in IT, makes the problematic process of adapting, developing and using IT (Walsham et al. 1988). Nevertheless, the lack of expertise in rural areas to deal with local problems influences the sustainability of HISs because of several reasons. On the one hand, people with little or no domain understanding of analysis, design, implementation and management of IS are left in control over the systems when donor and external experts disappear. On the other hand, not having general expertise nearby, e.g. for fixing computer hardware, shapes the way projects are run, and creates overwork among those who have the expertise. In scaling up, the system is affected by diversity of resources available at the different geographical locations. Resources available at one place, may not be available at the other, thus different problems have to be dealt with differently, consequently constraining the project in time and resources, adversely influencing both the scale and sustainability of the system.

Other cultural challenges

Lippeveld et al. (2000) mentions the need to have high-level interest and sponsorships as a precondition for a successful implementation of HIS. This means that senior officials and decision makers with strong commitment and political influence must be heavily involved in the restructuring of the HIS. In developing countries, like for instance in India, where “networks” and social “connections” play significant roles for getting support (Frøystad et al. 2000), corruption frequently occurs (Tully and Wright 2003). As mentioned above, these political “networks” and “connections” are unstable and short-term, and thus influence sustainability.

Furthermore, Heeks (1995) argues that new computerized information systems cannot alone solve the difficulties of corruption because “corruption is a phenomenon rooted in the cultural, political and economic circumstances of those involved. Computerization does little to affect these root causes, and so cannot eliminate corruption.” (p. 11). Similarly, Monteiro and Hepso (2000) describe how decisions within organizations may be “soft-corrupt” because of the status of the company who offer services. Working with renowned companies or agencies gives more status to organizations and the decision-makers, as compared to smaller and more local companies or agencies that perhaps have a better solution (and better intentions). Not being the “right” company or agency may thus affect the sustainability and the scaling of the information systems, for example because it is not local and thus cannot provide immediate support. Because HISs are implicated in all these root causes, the scalability and sustainability of the system may be affected in a negative way exactly because it deals with changes within the cultural, political and economic context.
2.4 Summary

When implementing new IS in developing countries, the context has to be taken into consideration because of the complexities of dealing with politics, bureaucracy, organizational change and infrastructural problems. Addressing globally related problems, like poverty and HIV/AIDS, needs to be to successfully implemented HISs. Nevertheless, most HISs implementation in developing countries are at a small scale and unsustainable, and thus do not fulfil the goal of improving health for the common man. The implementation challenges relating to these failures in developing countries range from political instability, short-term donor funding, to the lack of proper infrastructure, and cultural differences.

In order to analyze why HISs are successfully implemented or not, many IS researchers argue for seeing IS as social systems made up of a web of social and technical elements. In additions to the social aspect, because HIS span across organizations and geographical borders, it is important to go beyond traditional development strategies. ANT and the conceptualization of HIS as HII are hence useful theoretical perspectives in analyzing crucial problems of scale and sustainability of HIIs.
3 Research approach

3.1 Introduction

This chapter describes different research methods used during my fieldwork. The fieldwork was conducted both with a micro and macro perspective with a main focus on qualitative data. This approach enabled understanding of both the difficulties at the grass-root level of the sub-district and the policy level of the state. The primary objectives of my visits to Andhra Pradesh was to support the implementation of the minimum dataset based on local participation, interact in training of health staff and trainers, and work on integrating HISP with a name-based HIS (called FHIMS). This required me to work closely with various stakeholders including the health staff, local training institutions, government officials at various levels, FHIMS developers and project leaders.

Broadly, I adopted an interpretative approach based on an action research framework. Interpretative studies generally attempt to understand the nature of a phenomenon through meanings that people assign to the phenomenon. Within IS, interpretative methods “aim at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context” (Walsham 1993, p. 4-5). The understandings helped me to take action, for example doing system development and reflect on the effects of that implementation. The following sub-sections give a brief overview on HISP as an action research project and on the early phases of HISP in India. A more detailed description on these issues are further given in chapters 4, 5 and 6.

3.1.1 HISP and action research

HISP is a large action research project that is ongoing in several countries (see figure 3-1). The project originally started in the Republic of South Africa in 1994 as a collaboration between researchers from Norway and South Africa. The HISP network has since then spread to other developing countries, including Mozambique and India, which are now two important nodes within this network. An important part of the HISP network’s research has been to study how technology transfer from country to country and how Scandinavian-based participatory development efforts are applicable in different respective countries (Braa et al. 2004). To study this, an action research approach has been adopted in various forms throughout all nodes in the HISP network (ibid). According to Rapoport (1970): “Action research aims to contribute both to the
practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework” (p. 499). Action research has its foundation in the interaction between researchers and stakeholders to together define, solve and learn from problems. The research process can be seen as a flexible spiral process that allows action (change, improvements) and research (understanding, knowledge) to be achieved at the same time. During this process, researchers learn and execute social research techniques, take action, and interpret the results based on what they have learned (Greenwood and Levin 1998). Learning through participation is a major aspect of action research. The idea is that participation promotes democracy and commitment within organizations and communities, and furthermore that this generates knowledge among researchers and stakeholders. Action research, then, is concerned to enlarge the stock of knowledge of the social science community, an aspect that distinguishes it from applied social science, where the goal is primarily to apply social scientific knowledge rather than to add to the body of knowledge.

Nevertheless, many action research projects fail to persist over time (Braa et al. 2004). Englestad and Gustavsen (1993) argue that a major challenge is the shift of focus from “single organization and workplaces … to networks” (p. 219). Braa et al. (2004) further argue that action research projects become unsustainable because of issues related to scale, and state that “local action research must be conceptualized and approached as but one element in a larger network of action in order to ensure sustainability [because] local interventions depend heavily on the support of similar action research projects in other locations” (p. 4). They thus propose the term “networks of action” as an alternative to conduct action research on large scale HIS research projects, which means

![Figure 3-1: The HISP network](image-url)
that the research is spread throughout larger areas, and focuses on learning from shared experiences not concentrated in one single area.

### 3.1.2 HISP in India

Prior to my arrival in India in 2002, the HISP project had already begun in early 2001 after approval from the government of Andhra Pradesh. A situation analysis of the district where the project originally was situated, Chittoor, was first conducted, before preliminary work on standardizing the minimum data elements, and initial training was conducted. Furthermore, the database was later populated with the organizational health units in the district of Chittoor alongside the minimum data elements agreed upon. An action research approach was used in creating the early working prototype application for the primary health centres.

### 3.2 Research setting

My empirical work was carried out in the state of Andhra Pradesh over a total period of five and a half months, spread over three visits in 2002 and 2003. Andhra Pradesh is one of India’s largest states with a population of over 75 million inhabitants, and it is divided into 23 districts, each of them having a population from 2.5 to 5 million. The state is known for its drive on socio-economic development through the use of IT, and as being one of the hubs in the Indian IT triangle (Bangalore and Chennai are the other two). This growth has attracted many outside donors, like WHO, World Bank, and IMF, to sponsor economic aid to various different development projects, relating to health, education, agriculture, ICT, etc. Nevertheless, primary health care in Andhra Pradesh is poor. The actual health status of the people in the rural Andhra Pradesh reflects the poor functioning of the public health care.

The HISP research team was put together from several academic fields as a consequence of the multidisciplinary environment perspective adopted by HISP. The coordinator of HISP in India, Zubeeda Quarishy, is an Indian social anthropologist. She is in charge of administrative issues, guiding students and is doing research. Usha Srinath, a medical doctor doing her PhD on HISs, has been involved in the medical issues, especially on standardizing the minimum data set. Two professors in IS research from the University of Oslo were also involved in the project; Jørn Braa is the coordinator for HISP internationally, and Sundeep Sahay is an Indian researcher monitoring HISP, especially in Andhra Pradesh. I also worked closely with three other Norwegian master students during my fieldwork. Trude Larssæther, Nina Meland (both informatics) and Maria Røhnebæk (social anthropology) who were all doing research on HISP on their respective topics. In addition, I worked closely with two Indian programmers and several local computer-trainers. As HISP is situated in a global context, I also had contacts with HISP members in South Africa and
Norway. E-mail was extensively used to communicate and to get technical help, especially from developers in South Africa.

Most of the empirical data for the micro-level analysis was gathered from the town of Kuppam, one of the most poor and remote village areas in Andhra Pradesh (see chapter 5). However, being the political constituency of the previous chief minister, Mr. Chandrababu Naidu, Kuppam has in recent years attracted several technology based projects promoting socio-economic development. After some initial work in Chittoor, the district’s capital, the HISP project was initiated in Kuppam on the instructions of Mr. Naidu. The fieldwork in Kuppam was primarily carried out in nine primary health centres and one area hospital, which covers approximately 320,000 people.

I also spent a total of four weeks in Hyderabad, the state capital and political centre. There were two main sources of data collected at this level. One, I met with senior officials of health (for example, the Commissioner of Family and Welfare) and IT dept (e.g. advisor on IT to the chief minister) which helped me to understand the state perspective on HIS issues, for example how universal targets are set and implemented on all primary health centres. Two, I worked with CMC Ltd. (Computer Maintenance Corporation) employees who were the developers of the FHIMS (Family and Health Information Management System) software which was promoted by the state. CMC is an IT solutions provider that is based in India with approximately 3,000 employees, and is a part of the Tata conglomerate. Through this work with CMC, I worked to develop an integration tool to link DHIS (HISP’s management application, see chapter 4.1.2) and FHIMS.

3.3 Data collection

Most of the research is based on qualitative methods to collect data. The choice between qualitative or quantitative, or a combination of these two methods, should be based on what you want to study (Silverman 2000). A qualitative method aims at understanding social phenomena including background about persons and situations using collection methods such as interviews, observations, and analysis of documents and pictures (Thagaard 1988). A qualitative methodology was used to understand and develop deep insights in the variety of challenges to scaling and sustainability at all levels. However, some quantitative methods were used (see chapter 7) to analyze the raw health data collected from the primary health centres to make inferences on data quality and consistency.

In Kuppam, I was actively involved in customizing DHIS so that it could be easily used to register monthly health data from the primary health centres in the district, and to generate the required routines for reporting. This involved
customizing the database application to fit local needs, conduct training, participate in formal and informal meetings and discussions with various stakeholders including trainers and team-members. I worked very closely with two Indian programmers and the medical doctor to customize DHIS. I also worked on implementing the minimum data set and on creating simple reports. Furthermore, I was involved in training staff at the primary health centre and I educated the local trainers on how they should carry out the training. The different methods used are briefly elaborated below.

Language clearly affected how data collection took place in Kuppam. Most of the health staff, except the primary health centre doctors, spoke little English. The translations were for the most part done by the local trainers, who were themselves often not fluent in English. Misinterpretations often took place. It is also likely that my background as a foreigner affected how interviewees answered questions and my presence affected how informants behaved during observations. For example, because of HISP’s close ties with the government, it was often believed that we would report directly to government officials, and thus the health staff would try to show a lot of interest and enthusiasm for the software when we (HISP members) were around.

3.3.1 Interviews

I conducted a number of informal and semi-structured interviews. On the one hand, I interacted with HISP members globally to understand technical challenges and also implementation issues especially related to issues of scale and sustainability. On the other hand, I did several interviews with the health staff at the selected primary health centres in Kuppam to gain qualitative inputs into the many practical problems experienced by the actual users of the system. Most of the interviews at the primary health centres were done during breaks and were very informal, usually lasting between 10 to 30 minutes. In addition, I also had informal interviews with government officials in Andhra Pradesh and Kuppam, usually lasting from 30 to 60 minutes. During interviews I took notes, which I later wrote in more clear text.

3.3.2 Observations

I frequently visited the primary health centres to conduct observations relating to training and registration of health data. As most of these visits where unannounced, it gave us the possibility to check whether computers were actually in use, how, why and by whom they were being used. Observations were also made during training sessions conducted at both the primary health centres and in class rooms. We monitored how the computers were used, the interest of health staff in learning, and their level of enthusiasm. As observers we potentially could have also influenced behaviour (Braa and Vidgen 1996).
Furthermore, frequent visits to the primary health centres gave insights into infrastructure related issues, including transportation, power supply, state of buildings and furniture, conditions which influence issues of scale and sustainability. Moreover, we studied various artefacts, for example documents, local and central health reports, proposals, political vision statements etc. These were gathered at the primary health centres, from other government offices and by searching the internet.

### 3.3.3 Questionnaires

Two questionnaires were conducted in relation to training and system usability. The first questionnaire was handed out to health staff after a three day introduction training period; the second after the system had been in use for a month. While I was not directly involved in the questionnaire preparation and administration, I was given access to the data by the three other Oslo students with whom I worked together as a team.

The first survey contained questions about the training sessions, the software application (DHIS), and the users’ general view about computerizing the primary health centres. The second questionnaire was a follow-up to the first one, in addition to trying to reach users who did not attend the introductory training session. Both questionnaires could be answered in either English or Telugu (the local language) as most of the health workers spoke and wrote poor English; it is assumed that only an estimated five percent of the Indian population speak English well. The questions answered in Telugu were later translated to English by the local trainers in Kuppam. Nevertheless, the questionnaires gave empirical data that helped me gain a wider knowledge on the problems of scale and sustainability in relation to HISP, for example related to infrastructure and workload.

### 3.3.4 Training

Most of the teaching I did was directed towards the local trainers. This was because direct training of the health workers would be too difficult due to the language problems described above. The local trainers were hired through a local training institution in Kuppam (called Aptech) that primarily run courses in general computer skills. The faculty at Aptech had good knowledge of teaching the basics of the Windows operating systems, Microsoft Office, and basics of computer hardware. However, they had (understandably) poor knowledge of the HISP application and how to handle primary health data. They were given, prior to my arrival, a two week introduction course on these issues, but this was not adequate. Thus, training was primarily directed towards general knowledge as on the DHIS application, and to redress some of the earlier misunderstandings that had been made, for example related to updating the database.
3.3.5 Systems development

I conducted systems development along with other HISP programmers at two levels. One; was the development of a working prototype for the primary health centres in Kuppam. Two; the development of a working prototype for transferring data from FHIMS to DHIS. The latter took mainly place in Hyderabad together with the CMC employees in the second stage of my research. Engaging in this action helped me to gain a rich understanding of both technical (for example how to populate name-based data from the FHIMS database) and social problems (for example the challenges in getting political and bureaucratic support for the integration tool at the higher levels).

Developing a working prototype of a database (DHIS) for the Kuppam primary health centres involved work on standardizing the data-elements; observing, interviewing and training health workers; training and discussions with the HISP-team members and the Aptech faculty; discussions and interviews with government officials and ministers; and working closely with an Indian national who already had spent some time in the field working on similar problems. The empirical basis for creating this prototype was collected in both Kuppam and in Hyderabad. The observations, training, interviews and discussions helped me to get a detailed picture of the micro-level problems for developing a HIS in a rural context, and to develop a better prototype based on local needs. The interviews and discussions with officials in Hyderabad helped me to better understand the underlying political and social structures that need to be taken into consideration to create a HIS for Andhra Pradesh. Discussions with field workers and medical doctors at the primary health centres gave input on reports and how to customize the application for local needs. This took place as an iterative process.

To develop a prototype that converts data from FHIMS to DHIS, I participated with several developers and project managers to better understand the FHIMS database structure and how the application should be implemented and distributed. As the FHIMS project was a very prestigious HIS project for Andhra Pradesh, I got the opportunity to speak with several ministers, government officials and important NGOs. I thus got a clearer understanding of the politics concerning the FHIMS project and with it, deeper insight into the challenges of scale and sustainability.

3.4 Data analysis

The approach used to analyze the empirical data collected was primarily interpretative. A typical challenge was to deal with misunderstandings and misinterpretations associated with working in a foreign context that is very different from my own. However, since I made three trips to the research site, with each trip I gained deeper understanding of the situation and the complexities. Dis-
cussions with other HISP team members also helped me to clarify my understanding of the relevant issues.

The qualitative analysis took place through discussions with team-members from Oslo and India, discussions with my supervisors and reading relevant literature. The field data analysis was based on notes I collected throughout my fieldwork in my notebook and through e-mail notes I had written to my supervisors about progress when I was in the field. Discussions were done both in India and Oslo and were mostly informal other than some formal meetings in India. My analysis of field data and discussions with various people contributed directly in making changes to the strategies on implementation of HISP.

The quantitative data analysis was done based on various health related data captured in DHIS, which had not previously been subjected to any systematic analysis. Together with another student, I started to analyse the health data we had, and presented our analysis in the form of a report which we submitted to seniors of the health department and also my supervisors. Discussions with the doctors about the findings of the analysis provided further inputs to our understanding.

The topics of scale and sustainability became very apparent during the early stages of my fieldwork. The field data, discussions, the health data analysis, and studying relevant literature helped me to gradually both conceptually and empirically understand the challenges and the opportunities for a scalable and sustainable HISP in Andhra Pradesh. Through the action research conducted over three visits to the research sites, I was able to better understand the issues from a micro and macro perspective. The analysis presented in this thesis is based on this interpretative study within the action research framework.
4 A background on HISP

The main goal of HISP is to develop a district based health information system that includes software, methodologies for health information management, training programmes, health data standards and a data dictionary. HISP’s vision is to:

“Support the development of and excellent and sustainable health information system that enables all health care workers to use their own information to improve the coverage and health care within our communities”

(www.hisp.org, 10/18/2004)

HISP started in South Africa after the advent of democracy in 1994 as a research and development programme, much inspired by the Scandinavian tradition of democratic and union based action research and participatory approaches to information systems (e.g. Bjerknes et al. (1987)). The overall objective in South Africa was to explore and develop African approaches to participatory and bottom-up design, and develop a health information system. A key research objective was to find ways to empower and give voice to the community of end users, local management structures and deprived communities, in the process of developing a new health information systems to support the proposed decentralized health structures in South Africa (Braa and Hedberg 2000). Over the years, HISP has grown to be a part of the National Health Information System of South Africa, and has also expanded to other developing countries, for example Mozambique, India, Ethiopia, Tanzania and Malawi.

The following section gives a detailed background on HISP, and the next an introduction to the software used by HISP, called DHIS. This will give a framework for HISP on the issues of scale and sustainability in most of HISP’s nodes. The last section discusses the various methods and approaches used for deploying HISP in the various nodes. Placing HISP India within a global context is important in order to understand how the intra- and inter-country dynamics influences issues of scale and sustainability in India.

4.1 HISP – a background

In 1994, South Africa inherited a health care system from the apartheid regime, where 60% of the resources were used by the private sector but served
only 20% of the population. The new ANC government launched a programme to restructure the health sector with the aim to support communities that had suffered under apartheid, and to transform the highly specialized and centralized health system to a decentralized health system based on health districts (ANC 1994). HISP grew out of this reconstruction programme with the aim to develop a district health information system to support the emerging decentralized administrative structure (Braa and Hedberg 2000).

In South Africa, HISP started as a pilot project in three districts in the Cape Metropole in 1994. During the first two years, HISP spent considerable resources in building relationships, having meetings, reducing fears and suspicion especially among local health staff (Braa 1997). The pilot project continued rather successfully until NORAD stopped funding the project in 1998. As it seemed as HISP would die, just as many other pilot projects, a few important things happened that made HISP sustain (Braa and Hedberg 2002). First, all of HISP’s “competitors” were broadly seen as small fiascos, and HISP was the only primary health care pilot project left standing. For example, a high tech tick sheet system that was favoured among many provinces collapsed. It was technically fragile and too expensive, but a more fundamental problem was that it was collecting a lot of patient data but only using it for statistical purposes and presented a highly cost inefficient solution. Second, working at the grass root level paid off, as health staff started to come forward and explained to the higher level authorities how HISP had supported them in analyzing and using data. Third, a national survey of HIS in South Africa, conducted by two evaluators recommended using HISP to produce the first national EDS (Essential Data Set).

Hence, because these alternatives had collapsed, people continued using HISP in Western and Eastern Cape, which led to a broader adoption of DHIS. In 1998, as a result of the success, HISP was implemented in Western Cape. At this time, HISP also presented a well functioning DHIS to an American expert from the EQIUTY programme, which resulted in funding from USAID. In February 1999 practically all provinces (with two-three exceptions) wanted to drive the HISP/DHIS route. Finally, HISP was in 1999 accepted as the national standard for National Health Information System of South Africa (NHISSA) (Braa and Hedberg 2002).

In the following sub-section I will provide a brief summary on the HISP in different contexts, with a focus on issues of scale and sustainability.

4.1.1 Summary of development of HISP in key node countries

As seen in figure 3-1 on page 21, the major nodes in the HISP network are South Africa, Norway, India and Mozambique. Norway supports these countries in teaching, development and funding. Malawi, Tanzania and Cuba are
interesting examples on the issues of scale and sustainability within the network and are thus mentioned here. Ethiopia, Tanzania and Vietnam are also briefly mentioned.

**South Africa**

The background for South Africa is given in the section above, and thus a summary of the most important factors for scale and sustainability are given here. Up to now HISP has been successfully implemented and institutionalized in all South African provinces. The most important reason for this success is described as the success of HISP in a few districts, the failure of other HISs in other districts, and the domino-effect this created. Because the decision-makers in the non-HISP provinces had no other alternatives to promote, and that HISP had proved successful in other provinces, HISP was able to scale reasonably fast within the country. Furthermore, the rapid scaling led to a foothold for HISP, eventually in every province, and has made HISP sustain as a HIS actor in South Africa, for about 12 years now. Furthermore, the political benefits and standardization advantages that HISP gained through the “EDS recommendation” were valuable for scaling and sustainability. The grass root level approach scored valuable political points which also benefited HISP in terms of scale and sustainability.

**Mozambique**

Mozambique became the second node after South Africa in 1999 and created the international network. The initial aim in Mozambique was to develop a HIS in three pilot districts (see Braa et al. 2000). The key problems identified were related to poor reporting and poor data management systems, no feedback of information, and poor communication between district and province levels. Another problem was the impossibility for health facilities and districts to make local decisions. As these problems were addressed in the three pilot districts, it soon became clear that development at district level needed “to be interlinked with action and capacity development at province level, since this level is both the receiver of the data and responsible for supporting the district. Data from only one out of 12-18 districts on a province is not useful for the provincial administration” (Braa et al. 2004). A DHIS database with data from all provinces in the country was presented to officials to highlight the importance of this. Braa et al. (2004) describe the complexity on how HISP has failed to achieve success in Mozambique, i.e. has not been able to scale sufficiently and be self-sustainable in the country.

The highly centralized government in Mozambique made it difficult for HISP to adapt to local needs. Although HISP had contractual commitments with the Ministry of Health (MISAU), the official support for the project was in reality poor. For example, a decision to change the HIS software would require a decision from the central government, making it difficult for provinces and districts
to do their own development. The reason for little official support can additionally be explained by the country’s donor dependent economy. Since the country is so economically poor, it is very much dependent on donors to sponsor many of the pilot projects that are initiated in the country. The government is thus unable to turn down donors that bring money and other valuable resources into the country. The negative side of this, from HISP’s point of view, is that competing approaches from different donors are initiated simultaneously, and culminate as a pilot project after some time. Furthermore, Braa et al. (2004) describe how HISP, because of its status as a research project, was reluctant to get support. Most donors and MISAU focused on HIS in provinces, while HISP was perceived to explore and develop solutions for the district. HISP was because of this little involved in planning province related issues. Finally, it has been problematic to scale HISP in Mozambique because of the difference in available electricity from district to district.

The Ministry of Health selected DHIS as the database to use in future HISs, and thus relying on further support from HISP and a decision to implement DHIS nationally was made. However, since 2004 the project has made little progress and is currently at a halt in Andhra Pradesh.

**Other nodes**

Malawi is another node that has done reasonably well within the HISP network (see Braa et al. 2004). HISP was initiated in two pilot districts in 2001 after a request from the country’s health ministry, and implemented nationally in early 2002. The reasons for Malawi’s relative success can be described by four key reasons. First, the entry through the health ministry, with full support and devotion, speeded up the process compared to e.g. Mozambique where the entry was through university collaborations. Second, quarterly reporting, instead of the usual monthly reporting, gave more time to fine-tune the system. Third, all district- and hospital information officers were given a two weeks course in HIS to improve understanding and use of HISP. Finally, sufficient funding and good support from South Africa has contributed significantly to the sustainability HISP has achieved in Malawi. It has to be noted that Malawi is one of the poorest countries in the world with a highly lacking educational and human capacity infrastructure. For HISP to scale to a nation-wide implementation and stay sustainable for four years is impressive.

Tanzania had initially the same approach as Malawi, but the outcome is not so optimistic. In short, Tanzania have not had the same external and financial support as Malawi, and together with poor local support, this resulted in the project being halted. The project has been re-initiated through a university collaboration, with the aim to develop and pilot a new HIS in two districts and later implement it in a city.
Cuba is another interesting node, even though HISP as a pilot project has been terminated. The major reason why the project was terminated was because of a change in the political climate in the country, and the political support was quickly lost. However, set aside the political reasons, Sæbø and Titlestad (2003) criticize how the (Scandinavian) user participatory approach was used in this country, arguing that the approach was misplaced in a country so far from democratic values.

4.1.2 DHIS – District Health Information System

DHIS (District Health Information System) is a management software application tool that is used by HISP to capture and analyze health data. The tool has been under development since 1996 using an iterative development process primarily based on cyclical prototyping and participation from HISP users in South Africa. Over the last years, countries like Mozambique and India have contributed more and more in this development process and have made several changes to the tool because of the new contexts DHIS has to be adapted to. DHIS is an open-source project (see e.g. www.sourceforge.net) that encourages anyone who is interested in participating, to join the development process and use the software for free.

The health data analyzed using DHIS is primarily based on non-individual entities captured at facility level or aggregated health data at higher levels. The reason for this approach of collecting health data is the reduced complexity it gains in handling large amounts of health data, and at the same time be able to support decisions based on the data captured. The main argument behind this approach is that reduced complexity promotes increased sustainability and scalability of the system. It is much easier to scale a HIS and keep it sustainable with simple health data compared to complex name-based HIS. The trade off is less disaggregated analysis and the inability to follow up specific patients.

As illustrated in figure 4-1, DHIS has six major components that constitute the main and most important part of the application. The GUI (Graphical User Interface) is where the user enters health data that has been collected in the field, semi-permanent (survey) data, defines indicators etc. The GUI reads the desired language data (e.g. English, Portuguese, Spanish, Afrikaans, or Telugu) from the language component. All health related data is stored in the back-end database. This design has been developed to reduce the size of the database by allocating one back-end file within a suitable geographical area, and thus it is easier to scale the application. Another reason is because it enables the developers more freedom to update the GUI component. Because of design reasons the back-end file is slow in handling large amount of data for analysis, and thus data is converted into the data-mart, enabling fast analysis of data using either predefined reports in MS Access or customizable pivot-tables in MS Excel. The
A background on HISP data dictionary, which is not yet in full use, is where information about what to collect (data elements) and the definitions of these elements is stored.

![Diagram of HISP components]

**Figure 4-1: DHIS components**

The application has been designed to be as flexible and user friendly as possible in order to operate over geographical borderlines in developing countries. The application is flexible because it allows users to configure the application for local needs that triggers decentralization. For example, data elements may typically be different from one geographical area to another because of various reasons. Local managers can then configure the application so that it captures health data that are important within his or her area and that corresponds to reporting levels above. Furthermore, flexibility promotes decentralization because managers would feel more responsible for the health data they register.

The application has been made as intuitive and user-friendly as possible. It has for instance a GUI with large buttons, icons, and on-screen help in several languages (see figure 4-2). Figure 4-3 illustrates another part of the application that is much used by those who collect health data. In this screen, the user must first choose an area and for which month the health data has been collected, and then enter data in the data-elements displayed. If the entry is outside the minimum and maximum values, a comment has to be included. Other features accompanying this screen are, for example, the possibility to run complex validation rules, see timeline graphs for a data-element, and do regression analysis for a data element.

Nevertheless, the application has experienced several problems relating to coding and development. Developing in MS Access has for example made it difficult to do cross-country development. Although the application is open-source, changes done to the application must be done in one central place because of
the way Access works. Furthermore, because this central place is in Cape Town in South Africa, the application has been biased towards the South African context. The ongoing (2007) development of DHIS 2 may however change this. The new version builds on the same principles as the previous version, but is completely rewritten using Java technology and frameworks like Spring and Hibernate. This technology might simplify inter-country open-source development, e.g. through the use of a revision control systems like Subversion.

Figure 4-2: GUI in DHIS: Starting screen

Figure 4-3: GUI in DHIS: Routine health data entry
4.2 Analysis of HISP’s strategy on scale and sustainability

As mentioned in the section above and illustrated in figure 3-1 (p 30), the HISP network is made up of several nodes from various developing countries and Norway. To better understand how HISP relates to the issues of scale and sustainability, it makes sense to analyse issues on how HISP has scaled and sustained across and within the network. The challenges for HISP to scale and achieve sustainability within new countries are many, and how to better understand these issues is the topic of my thesis.

4.2.1 A different HIS

The governmental-university based crossover means that HISP differs a lot from most other HISs in developing countries. HISP has one leg in the academic world for innovation, research, development of new strategies, methods, software etc, and at the same time it has close ties with the Ministries or Departments of Health (in each of the countries involved). In some of the countries, the main counterpart is the ministry and in others it is the University. Thus, having one leg on the inside, and one on the outside, stakeholders are part of the internal process and can provide input and influence and be a participant. At the same time, HISP has the freedom on the outside to continue the more innovative part of development. For example, there have been several cases where the Department of Health in South Africa and provinces have demanded a higher degree of control over HISP, also regarding the innovative process. HISP has consequently rejected these demands, which has been accepted by the stakeholders in South Africa because the system there has been so successful.

Although HISP has this academic leg which controls the innovation process, it does not mean that the various governments cannot influence this process. HISP strives to follow a democratic approach that is driven by people with the greatest influence of ideas, solutions or even sometimes just a request. People that interact in a constructive manner have a lot more influence over the innovative and development process than people saying “I am the chief director of this or that”. Power structures are not irrelevant, but people see that software innovation cannot be run using a technical committee which has been put together based on political compromises. The checks and balances in relation to HISP’s innovative process have been that others are also innovative, and can influence the process.

On the one hand, the academic entry gives HISP easy access into a district or province. It is much easier to start collaboration with an academic institution compared to the health-ministry in e.g. a province. In addition, collaboration between academic institutions is easier to keep sustainable because less funding
is required, and it is thus possible keep the project going for years with a relatively short amount of money. On the other hand, one difficulty of involving academic institutions is to scale the project up to a level that is useful for health-managers, and thus be able to show the usefulness of the project to decisions-makers. A governmental entry has a clear advantage in that is gives direct access to the core working area. With good support from the political and bureaucratic arena the possibilities for a working HIS are greatly improved. However, having sustainable governmental backing is often difficult to achieve; it is often transitory because of funding and the changing political playground.

In most cases of HISP implementation in a country, the entry has been through the academic port and initiated with a survey and subsequently a small pilot project in a nearby area. Transcending from the academic to the governmental side has in most cases been difficult and time-consuming. A consequence of this is that it is easy to start HISP in a new country, but keeping it self-sustainable is a bigger challenge.

4.2.2 Technology and political alliances

On the one hand, HISP’s main focus is explicitly on software and information technology, and because of this focus HISP has been more accepted as a health information system in developing countries. On the other hand, the software is flexible and has a number of options that make it adaptable. But the fundamental thing about HISP is the approach of initiating the project in another country. This bottom-up approach is a political ideology of a health information system, which predominantly is related to local data capture and use of information. Alliance building and political manoeuvring can be seen as an aspects of HISP as it deliberately builds bridges and alliances with constructive, progressive people who want to see something done. These alliances can be anything from NGOs to public sectors or academia. The main idea behind such a thought is that political alliance building and how one are interacting with different people at different times is as important as the technical brilliance of the solutions.
The Republic of India has been the world’s largest democracy for 60 years, after independence from Britain in 1947. India is more a continent than a country with its enormous varieties and diversities. The differences in culture, language, customs and country are striking. Change is inevitably taking place as modern technology is woven into the fabric of society, yet essentially rural India remains much the same as it has been for thousands of years (Singh et al. 2003). With 1,065 million people (2003), India has the second largest population in the world with a growth rate of 2%. By 2050 India is expected to exceed China and reach 1,563 million inhabitants (Economist 2005). There are 15 official languages, the largest being Hindi (30%). English is only spoken by around 5%, but it still remains as a official language in the bureaucracy. Despite India’s many large cities, it is overwhelmingly rural – it is estimated that about 72% (2002 est.) of the population lives in the countryside (UNDP 2002).

One of the world’s greatest religions, Hinduism, was founded in India. 81% are Hindus and hardly any other country has its religion so intertwined with everyday aspects of life. For those educated in the Western liberal tradition with its basis in logic, this can be often hard to understand. They live from dusk till dawn and from season to season, and the time aspect is quite different than in the western cultures (Singh et al. 2003).

The lack of knowledge in handling information is a cultural challenge in many developing countries. In India, power structures are often related to your caste, education and race (Sahay and Walsham 1997; Tully and Wright 2003), and the balance between these conditions are very rigid. The Nobel price winner in literature V.S Naipaul describes this issue in Indian social life:

“…the man who makes the dingy bed in the hotel room will be affronted if he is asked to sweep the floor;…the clerk will not bring you a glass of water even if you faint; …study these four men washing down the steps of this unpalatable Bombay hotel. The first pours water from the bucket, the second scratches the tiles with a twig broom, the third uses a rag to slop the dirty water down the steps into another bucket, which is held by the fourth.”
India, Andhra Pradesh and Kuppam

(Quoted in Sahay and Walsham 1997, p 421)

Such power structures affect sustainability and scale of HISs, because trying to change such deep-rooted economical, political and cultural habits is a time-consuming and sensitive topic, and seems unlikely to be dismantled easily (ibid.).

Politically, India is organized as a federal republic. There are 28 states and seven union territories and the constitution details the powers of the central and state governments. The responsibility for education is shared by the state and union and is compulsory and free for all up to the age of 14, although many do not attend school regularly. Only half of the children in the 11 to 14 year group are enrolled and half of all students from rural areas drop out before completing school. The national illiteracy rate is 39%, and includes more females than men (Census 2001). However, considering the high illiteracy rate, it is a paradox that India has the second highest number of educated people in the world, after the United States.

A few other key numbers for India related to health is presented in table 5-1.

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>Andhra Pradesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>1,027,015,247</td>
<td>75,727,541</td>
</tr>
<tr>
<td>Rural population</td>
<td>741,660,293</td>
<td>55,223,944</td>
</tr>
<tr>
<td>Number of literates</td>
<td>566,714,995</td>
<td>40,364,765</td>
</tr>
<tr>
<td>Birth rate urban (SRS)*</td>
<td>21.6</td>
<td>20.5</td>
</tr>
<tr>
<td>Birth rate rural (SRS)*</td>
<td>28.9</td>
<td>23.1</td>
</tr>
<tr>
<td>Infant mortality rate urban (SRS)*</td>
<td>45</td>
<td>37</td>
</tr>
<tr>
<td>Infant mortality rate rural (SRS)*</td>
<td>77</td>
<td>70</td>
</tr>
</tbody>
</table>

Source: Census 2001

* Estimated rates for 1997

Table 5-1: Demographic and health profile

5.1 Health care in Andhra Pradesh

5.1.1 The health care system

India started its health care reform in 1952 after independence from the British Empire in 1947. It was however not until 1983, in the Alma Ata declaration (WHO 1979), that the country turned away from medical care, and committed to primary health care and primary health centres. Andhra Pradesh, as a state in India, is committed to follow this national policy of providing preventive, promotive and rehabilitative health services to the people.

<table>
<thead>
<tr>
<th>Type of institution</th>
<th>Plain area</th>
<th>Hilly/ Tribal area</th>
<th>Avg. rural population served</th>
<th>Avg. number of villages served</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-centre</td>
<td>5,000</td>
<td>3,000</td>
<td>4,579</td>
<td>4.27</td>
</tr>
<tr>
<td>Primary Health Centre</td>
<td>30,000</td>
<td>20,000</td>
<td>27,364</td>
<td>25.55</td>
</tr>
<tr>
<td>Community Health Centre</td>
<td>120,000</td>
<td>80,000</td>
<td>214,000</td>
<td>200.07</td>
</tr>
</tbody>
</table>
Table 5-2: Primary care institutions; some statistical data

The Primary Health Care infrastructure in rural areas has been developed as a three-tier system and is based on the population norms presented in table 5-2. At the bottom level in the hierarchy, the sub-centre is the peripheral institution available to the rural population. A sub-centre is supposed to be, according to the government, run by one multi purpose worker (male) (MPHA(M)) and one multi purpose worker (female) (MPHA(F)). The MPHA (F)’s core tasks are to capture data about ante-natal cases, register births, and give BCG and measles vaccine. She executes these tasks by going from village to village within her area on a monthly basis.

The primary health centre (often referred to by its acronym, PHC) is the first contact point between the village community and the medical doctor. A primary health centre acts as a referral unit for approximately 6 sub-centres, has one medical doctor supported by 14 paramedical and other staff, and usually has 4-6 beds for patients. The activities of primary health centre involve curative, preventive, promotive and family welfare services in addition to simple daily-based services like vaccinations and blood testing.

Community health centres (CHCs) are being established and maintained by the state government. They are manned by four medical specialists, i.e. surgeon, medicine, gynaecologist and paediatrician, supported by 21 paramedical and other staff. It has 30 in-door beds with one OT, X-ray, labour room and laboratory facilities. The CHC serves as a referral centre for four primary health centres. The secondary and tertiary levels of health care are hospitals, situated in a mandal (an administrative area) and in a district.

5.1.2 The health information system

The flow of data follows the structure of the primary health care institutions. The collection of data is paper-based, and is aggregated at every level from sub-centre to the district. All communication between levels is done by post/hand delivery. There is only one computer at the district medical and health office. Every month the MPHA (F) fills out the forms at the sub-centre and delivers those to the person in charge at the primary health centre, usually the medical officer or the supervisor. Data is then calculated and summarized on forms for the primary health centre, and brought to the monthly meeting for all primary health centres in the district. The district then compiles the primary health centre data manually for delivery to the state.

Looking at the information flows in figure 5-1, the health information systems is thus a reflection of the hierarchical structures in the health sector down to the lowest institutional level.
5.2 Why Andhra Pradesh?

Andhra Pradesh, following the former chief minister’s agenda, has been known during the past few years for being a key proponent in India for using technol-
ogy and a people-centred approach to modernizing rural communities (see e.g. Zwingle 2002). Andhra Pradesh is widely being more and more famous for its IT policy and is among the top cities in India, next to Bangalore, in building ICT infrastructure. Hi-Tech City, in the suburb of Hyderabad, is hosting companies such as Wipro and Hewlett Packard, and is closely situated to several educational institutions. Furthermore, the former Naidu government of Andhra Pradesh strongly believed in e-governance when it came to IT (Tully and Wright 2003). The government was engaged in trying to provide good governance for the common citizen, and making a difference in the local communities. For example, e-governance services such as online access to government records and easy bill payment that traditionally required much time and money were set up.

5.2.1 E-governance in Andhra Pradesh

The Neidu-government had a vision of establishing a Simple, Moral, Accountable, Responsive and Transparent government – SMART government, and saw e-governance as one way of reaching these goals (see UNPAN (2000)). Several major projects have been implemented over the last six years to achieve this goal, including the following:

APSWAN: Connectivity is perceived to be the backbone of all efforts at e-governance. In particular, this is a 2 Mbps optical fibre connectivity that has been established between Hyderabad and all the 23 district headquarters (plus two other towns). It is furthermore thought that this connectivity can be broadened to the villages, and thus all citizens can take full advantage of the internet.

Video-conferencing facility: A video-conferencing facility between Hyderabad and 25 cities/towns that has been operational from the end of 1999. The data-stream is transferred over the APSWAN network, and is used by officials to conduct meetings on a regular basis. A further expansion is planned to include domains where video-conferencing is useful, for example specialized professional education.

CARD (Computer-aided Administration of Registration Department): Computerized registration of deeds and other services. Has successfully reduced the time it takes to register governmental services, and is recognized as a success within e-governance in India. To further improve CARD, a registration service based on remote access is planned.

COMPACT (Computer-aided Administration of Commercial Taxes): Building a database of more than 350,000 registered dealers where data is analyzed and used for taking up investigations to detect evasion of sales tax.
TWINS (TWIN cities Network Services): A pilot project to provide one-stop services to the citizens. Includes payments of utility bills, issue of certificates, licenses and provision of information useful to the citizens.

MPHS (Multi-Purpose Household Survey project): One of the largest IT projects undertaken by the government, which aims to create the database of the socio-economic data of all the citizens of the state. A more detailed description of this project is given in chapter 6.5.

APDMS: The Andhra Pradesh Development Monitoring System is a GIS-based system that was launched in the beginning of 2000. The project has created base maps with data on the road network, the community infrastructure, basic demographic data, soil and geomorphologic data.

Despite the prospects, the common man has yet to see the better of much of this reform. In fact, many comment that Naidu lost the election in 2004 because these projects did not live up to its promise. The many farmers (about 70%) living in Andhra Pradesh felt that more basic needs (like electricity and irrigation) were more important than ICTs. The mounting of Naidu’s two favourite hobby-horses, good governance and the benefits of IT, was apparently not appreciated too much by the voters.

5.3 Kuppam

Kuppam is a rural community located south-west in the Chittoor district and probably most known for being the electoral constituency of Chandrababu Naidu, the former chief minister of Andhra Pradesh. As a result of this, Kuppam became a test area for technology-based socio-economic development, and houses educational, agricultural, health care, and telecommunications pilot projects. A more detailed description of projects in Kuppam is given below.

The district Chittoor, with its population of about 3.75 million, is one of the poor districts in Andhra Pradesh, not only within health care. Several of the important indicators and targets for the districts are found unsatisfactory, so the district scores badly compared to the other districts. The data reported is to a large extent incomplete throughout the district. The maternal mortality rate for the state is officially 1.54 pr 1000 live births (SRS 1997), however, it is probably more around 4. The maternal mortality rate for Chittoor is 1.18. The infant mortality rate is officially 66 pr 1000 (SRS 1999) as an average for the state, but in Chittoor it is reported to be 12.12. These two examples indicate a poor reporting system that needs to be addressed.

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1 A presidential candidate has to win the political election in his electoral constituency in order to rule as chief minister in the state.
5.3.1 IT and initiatives in Kuppam

Kuppam hosts a wide range of IT initiatives ranging from wireless technology to basic computer studies. The two most well known projects are initiatives run by World Corps and Hewlett Packard (HP).

World Corps is an international non-governmental organization (NGO) which in collaboration with public, private and NGO partners in developing countries, identify promising young leaders from rural areas. These people are given a long-term, intensive training program designed to teach skills in business development, community development and global citizenship. After an initial period of training, World Corps has now opened Community Information Centres (CIC) in the five major towns or villages in the Kuppam constituency. The main purpose of these CICs is to make resources available to the rural and poor through the use of Internet and human resources. Services offered at the CICs range from providing Internet connectivity, printing, Xerox copying and dictation to selling jewellery and checking electricity bills. The plan is now to expand with 10 more CICs in collaboration with HP. These CICs could potentially be able to implement the states e-seva initiative.

HP i-Community is an alliance between HP and the state government of Andhra Pradesh who intend to accelerate socio-economic development in the rural areas by using information and communication technology to increase income opportunities and access to new markets. The ultimate goal is to improve literacy, job creation, income, access to government services, education and
India, Andhra Pradesh and Kuppam

healthcare in the constituency over a three year period. The HP i-community project seeks to build leadership and IT capabilities within the community and to establish a sustainable and replicable model for economic growth. The project has held a workshop and done surveys in the area, and has collaborated with World Corps to further develop their strategy.

Another technology worth mentioning is a plan to connect the town of Kuppam through wireless technology (corDECT) as one of the first rural town in the world. Broadband technology (1 Mbit) is also under progress to the town, something that would give a lift to the CIC and the numerous Internet Cafés in the area.

Mobile technology has also found its way to Kuppam. In May 2002, Airtel and Tata, two of the major cellular companies in the country introduced coverage and subscription. About 250 subscriptions are sold, equally distributed on the two companies (December 2002).

The Internet Cafés offer, in addition to ordinary web browsing, services like gaming, fax, CD-burning and printing. Prices for browsing are around 30 Rupees (0.70 €) for one hour, while gaming usually is a few rupees cheaper. Connectivity is fairly unstable and modems are usually shared across several PCs so browsing is usually slow.

In addition to what is mentioned above, there are also a few more non-IT initiatives in Kuppam worth mentioning. The LSFAP (The Large Scale Farm Advanced Project) is a holistic approach to modernize agricultural practices by involving agriculture and all related departments in the process of this technological upgradation. It revolves around an Israel cooperative model of agriculture. The chief minister has also initiated an Anti Child-Labour program, a program to help children from the surrounding 47 villages to come and study.
6 Fieldwork in Kuppam: Cultivating HISP

This chapter gives a rich description of the fieldwork conducted between February and May and between November and December in 2002. An introduction of Kuppam was given in the previous section, and I will now continue to describe how HISP was initiated. In the remaining sections, I present empirical data related to standardizing health data, the introduction of computers in the area, training of health workers, issues on working with a local private company, and the introduction of DHIS in the nine primary health centres in Kuppam.

6.1 HISP in Kuppam

As mentioned, the fieldwork was conducted over three periods in 2002 and 2003, the first from January to May, and the second a short month from mid November until mid December in 2002. My third visit to the research site was a stay in Hyderabad for 14 days in May 2003. Most of the empirical data gathered within the two first periods are from Kuppam.

6.1.1 Initiating the HISP pilot

In the aftermath of India’s liberalization policy during the 1990s and Andhra Pradesh’s e-governance ambitions – one of the pioneering states in India, HISP’s initial stage began in December 1999. The initiative came from a few professors from Oslo and Bangalore who had relations with a secretary in the Andhra Pradesh government. After some time, a choice was given between two districts in Andhra Pradesh to initiate the project and a quick survey was conducted to determine which district was best suited as a pilot area. The survey revealed that officials in the district of Chittoor seemed to be much more open and cooperative to the project compared to those of the Meddek district. Chittoor is also situated closer to the Indian Institute of Management in Bangalore (IIMB), a highly distinguished business institute were the project originally was anchored. Another reason for choosing Chittoor was that the district is quite remote from Hyderabad, the capital of Andhra Pradesh, housing the political and bureaucratic power of the state. The HISP project could therefore represent a more accurate dissemination of the e-governance initiative for the state.
In December 2000, the first phases were initiated: From January to February 2001 a situation analysis of the pilot district was done, and from February until August work on the minimum data set was initiated. In September, installation of the DHIS software and some training for a few key persons was conducted. The same month, a presentation to the chief minister was held and the outcome of this presentation resulted in a move to a smaller place within Chittoor, and to tie up with a local private company. Officials and political leaders from the meeting argued that support for the project would be better in a concentrated area. The pilot area was then moved from Chittoor to Kuppam in the beginning of November 2001.

6.1.2 Description of the primary health centres

This section gives a detailed description of the primary health centres and their sub-centres in Kuppam. The map below, figure 6-1, shows the primary health centres and the town of Kuppam, where HISP’s headquarter and “Area Hospital” is situated.

The nine primary health centres that surround Kuppam cover a population of about 320,000 people. Every primary health centre is approximately within one hour drive from Kuppam and there are frequent bus connections to most of them. The nine facilities gives a fairly representative sample for the district as they range from very poor to fairly good in terms of infrastructure and patient treatment.

Figure 6-1: Map of Kuppam and the nine pilot primary health centre districts. The green circles represent the approximate location of primary health centres.
The primary health centres vary in size, from moderately small to rather large in terms of both building and population coverage. The smallest primary health centre covers a population of some 7,000, has 2 sub-centres and no building. The largest primary health centre covers some 75,000 people, has 11 sub-centres and provides 24 hour open service. The other primary health centres are spread rather equally between these two extremes, covering from 25 to 40 thousand people (see also table 6-1).

Throughout Chittoor, telephones are working only in 15 of the 84 primary health centres in the district. The phones are out of order most of the time due to unpaid bills by the district medical and health officer’s office, often for as little as 200 €. In Kuppam, only three of the nine primary health centres have a telephone that is working. None of them provides access to the Internet.

Stable electricity is a major problem in Kuppam. Two of the primary health centres are supposed to have 24-hour electricity, and the rest have power at scheduled times that alternates every other week. Every day there are scheduled power cuts and very often there are unscheduled power cuts as well. In some primary health centres there are diesel generators to provide additional backup power, but this is not present in any of the nine health centres within the pilot site. There are however universal power supplies and in most cases batteries connected to the computers to keep them running for ten minutes (on universal power supply) to about two hours (with batteries).

It regularly happens that doctors do not show up for work at the primary health centre. Living far away from the facility and running their own private practice are two of the most common reasons for this. Although they are required to show up every day and that it is illegal to run a private clinic when employed at a public facility, not much is being done to improve the situation. The strong position of the doctor in the community stops many from bringing the topic forward, and having a remote village as a working place makes it difficult to attract new doctors to work there. In fact, according to the family welfare ministry, around 20% of the positions of a medical doctor in Andhra Pradesh are at all time available, and this is mostly because of the difficulties of keeping the doctors in the rural areas.

The female field workers are mapped to one sub-centre that theoretically is supposed to cover some 5,000 people. In practice, the population varies from 4 to 8 thousand. Their main tasks are to do family and welfare planning and basic nursery. For example, immunisations, ante-natal care, family planning information and education activities, school health programs etc, are all basically done through the sub-centres. They are also supposed to stay in one of the village they work in, but this is not the case in many of the 52 sub-centres covering the pilot area. The supervisor for the primary health centre is supposed to
check up the field worker’s work with spot tests, but this rarely happens. They are not supported with any type of transportation except for bus tickets, but in many cases there is no public transportation, so walking several kilometres every day is a daily part of their job. A sub-centre is supposed to have a building connected but of the 52 only a few have a building that can be used. Health workers are given 300 Rupees (around 6 €) extra salary per month for using their own house as a sub-centre.

The nine primary health centres were originally sanctioned one computer each, but some of them did not have the proper facility to keep it in. Three of the facilities had no power capabilities and one facility was not much used by staff, so the computer was after some time moved to the area hospital.
<table>
<thead>
<tr>
<th>PHC Information</th>
<th>Mallanuru</th>
<th>Gudupalli</th>
<th>Paipalliam</th>
<th>Santhipuram</th>
<th>Rallaboduguru</th>
<th>Ramakuppam</th>
<th>Vijilapuram</th>
<th>Veernamalla</th>
<th>VKota</th>
<th>Area Hospital</th>
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<td>Population old</td>
<td>23,486</td>
<td>30,922</td>
<td>52,560</td>
<td>22,523</td>
<td>22,421</td>
<td>24,397</td>
<td>11,300</td>
<td>6,424</td>
<td>64,000</td>
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<td>Population census ’01</td>
<td>37,174</td>
<td>38,376</td>
<td>66,448</td>
<td>28,049</td>
<td>24,507</td>
<td>26,865</td>
<td>14,302</td>
<td>8,714</td>
<td>74,750</td>
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</tr>
<tr>
<td>Pop. Diff. (old/new)</td>
<td>37%</td>
<td>19%</td>
<td>21%</td>
<td>20%</td>
<td>9%</td>
<td>9%</td>
<td>21%</td>
<td>26%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Patients pr day</td>
<td>100</td>
<td>150</td>
<td>120</td>
<td>120</td>
<td>250</td>
<td>50</td>
<td>N/A</td>
<td></td>
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<tr>
<td>PHC status</td>
<td>New building</td>
<td>Old small building</td>
<td>Good building</td>
<td>Good building</td>
<td>Good building</td>
<td>Poor facilities</td>
<td>No building</td>
<td>Upgraded PHC</td>
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<tr>
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<td>8am - 6pm</td>
<td>9 - 13 and 16 -18</td>
<td>9 - 13 and 16 – 18</td>
<td>24 hours</td>
<td>24 hours</td>
<td>9 - 17</td>
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<td></td>
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<td>2</td>
<td>11</td>
<td>6</td>
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</tr>
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<td>8</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>2</td>
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<td>1</td>
<td>2</td>
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<td>1</td>
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<td>8</td>
<td></td>
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<tr>
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<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>11</td>
<td></td>
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<td></td>
<td></td>
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<td>4</td>
<td>4</td>
<td>2</td>
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<td></td>
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</tr>
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<td>1</td>
<td>0</td>
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<td></td>
<td></td>
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</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>No</td>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<td></td>
</tr>
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<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>7 - 11 &amp; 13 – 17</td>
<td>Not currently (06.05.02)</td>
<td>Alternating</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes, in GP building</td>
<td>Yes</td>
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<tr>
<td>Distance</td>
<td>30 minutes by bus</td>
<td>15km, 30 min by bus</td>
<td>40 mins by bus</td>
<td>Very remote</td>
<td>60 km from Kuppam</td>
<td>60 min by bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Public transport</td>
<td>Frequent busses</td>
<td>Frequent busses</td>
<td>Frequent busses</td>
<td>Frequent busses</td>
<td>3 buses pr day</td>
<td>Frequent busses</td>
<td></td>
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</tbody>
</table>

Table 6-1: Overview of the nine primary health centres and area hospital
6.2 Training

I was involved in organizing parts of the training in HISP that included teaching the faculty at Aptech, a local private company, in DHIS and observation of the tutoring in general. Training in Kuppam was done in two ways; one part of it is done in classrooms and the other part was at the primary health centres. In addition, a group of the more experienced health workers were given local support and training so that they could support the process locally.

6.2.1 Classroom training

HISP arranged a two or three days training programme from time to time, mainly in Kuppam but also in other places were HISP has been established (e.g. in Chittoor). Many of the health workers had a hard time coming to the training for reasons of travelling and work pressure in the field. Sometimes field workers would not come simply because they had not received the message from the medical officer at the health centre.

Another problem of having classroom training was the tension between the doctors and field workers. For example, in one training session all the doctors took charge on using the shared computers available without letting any of the field workers have access, until the facilitator told otherwise. This power of doctors had a negative effect in that the field workers were passively attending the training session. A part of HISP’s objective in Kuppam is to empower the field workers through the use of computers, so much focus has been directed towards training them. At the same time, the doctors have to be included too as the manager of a primary health centre. The tensions were then inherent.

One way of involving the participants, and especially the field workers more at a training session, is to let them use the data they themselves collect. HISP are using this bottom-up approach to motivate the people working at the grass roots, to use and analyze the data they collect. In many of the training sessions in Kuppam, the participants, mainly field workers and medical officers, were told to bring their own data for the previous year. In one particular session they entered this data in a form which looks almost the same as the one they use in the field, except that it was in English. Working with their own data made them feel more familiar with the system. Although it was limited what the users could decide concerning standardization of the data elements, they gave important feedback for further development on reports and what to collect.

Classroom training has also been held by very experienced facilitators from South Africa. In this session, field workers, medical officers, HISP-India team-members, politicians, bureaucrats and health officials attended. The focus of these sessions was on the “use of information for action”.

6.2.2 Training in the primary health centres

To be able to give a closer and more independent follow-up of the field workers, it was decided to conduct training directly at the primary health centres that have computers. In addition, it was decided to do this because HISP needed to collect data for the previous year (2001), and the only way of doing so was to get it directly from each primary health centre and sub-centre. At scheduled times, health workers came to the health centre decided on by HISP to enter the health data into DHIS and to be supervised and educated by HISP trainers. These trainers were originally faculty from Aptech, but now many of the trainers work for HISP.

In the beginning the progress was poor. The field workers came with their diaries and read it to the trainer who punched it into DHIS. Often the health worker did not show up for the training and often the computer did not work (for various reasons as elaborated on under “Hardware problems” in section 6.4.1 below). This was due to three main reasons.

First, HISP was under pressure to show quick results, i.e. collect the health data for 2001 as fast as possible. The trainers knew this, and were pressured by HISP to accomplish this as fast as possible. Hence, they started typing in data themselves instead of making the health workers enter the data, speeding up the process quite extensively. Sometimes the trainers entered the data themselves without the presence of the health worker. This information was available at the health centres in the “broad-sheets”.

Second, some doctors did not like the HISP project, for various reasons, and did not want the field workers to be educated in using DHIS and general computer skills. One example is how a medical doctor had given the information that anyone who used the computer was personally responsible for it. Consequently none of the field workers would dare to use the computer. Another example is the numerous times trainers sat waiting in vain for the field workers to come. The medical officer (same as above) told he had given the message to the specific field workers, while, the field workers said they had never received the message.

Third, at an early stage some field workers acted quite indifferently in relation to HISP, and did not care much about learning the system as long as the job was done and no one got complaints. They did not see how their career or work would benefit.

Some field workers wanted to enter data in a place close to where they live. This was a sensitive issue to handle. The field workers, as well as doctors, are supposed to live very close to the primary health centre they are connected to and preferably in one of the villages she is responsible for. Some field workers who
lived in Kuppam wanted to do training and entering of data in the area hospital. Not having a computer or having a computer without power in the health centre would thus be a good excuse to enter the health data in the area hospital instead.

Nevertheless, conducting training at the primary health centres to some extent has been successful. Some field workers have learned how to use more advanced features in DHIS, like analyses of sub-centre and primary health centre data. The close follow-up individually has created a trustful relationship between the trainer and the field worker. Many complaints and suggestions have been put forward through the trainers and not directly to me or other researchers involved. One might assume that this is due to the fear of expressing criticism to foreigners and authorities. Finally, the need for several trainers to be at the health centres on a daily basis has attracted many locals to participate in the project. Many of the trainers are from Kuppam and the surrounding areas that help to gain self-sustainability to the project.

6.2.3 Local action group and reference group

Initiatives were taken by HISP to create a group of what is generally referred to as “super users” at the different health centre. This group, called “local action group”, was users that had a general good knowledge of the system, beyond the average user that could deal with difficulties “on the spot”, share experiences and deal with other issues regarding the project. The group included field workers and medical officers.

Neither the medical officers nor the special officer, a bureaucrat reporting directly to the chief minister, in Kuppam liked the idea of mixing field workers and medical officers into one group. In addition, experiences had proven that the medical officers easily took charge and did not give the field workers free speech. To please the doctors and the special officer it was decided to split the group into two parts; one with field workers and the other with medical officers. The group with medical officers, called “reference group” have neither done nor accomplished much, but the reorganization had to be done to please both the medical officer, and more importantly to please the special officer.

6.3 Local adoptions of HISP

Local adoption through participatory prototyping of DHIS, identifying health data standards and indicators, and identifying routines and procedures for handling information at health unit and district levels are the prioritized tasks to be dealt with when introducing HISP in a new setting (Mosse and Sahay 2003, p 21). The system is there to collect, validate, analyse and to make use of the information at local level. To achieve this, interacting with users and establishing routines are necessary. The design approach is evolutionary and incre-
mental, meaning the application is constantly changed in response to more research.

This section describes how these adoptions have been worked on and dealt with. First though, a short introduction of what local adoptions was done prior to my arrival in India.

6.3.1 Initial stages

In Kuppam, the initial pre-implementation started in September 2001 when a Master student from Oslo came and did initial work for HISP. Together with others, he first identified the minimum data set to be used, and collected a list of all primary health centres and their corresponding sub-centres in Chittoor. When this was done, the student then configured DHIS using the collected list.

One big obstacle experienced at this stage was the difference in hierarchical units supported by DHIS and number of units appearing in the health hierarchy. India, with its large population, has one reporting unit more than South Africa, and DHIS had no option for expanding the number of reporting units from five to six. The problem was solved ad-hoc by virtually melting together the two lowest reporting units (facilities).

The work on identifying the minimum data set for the Chittoor district continued with workshops and interviews with representatives from all levels in the hierarchy. Medical officers, field workers, nurses, the district medical and health officer, representatives from the department of family welfare were all involved in this process. The primary goal of the workshops and interviews was to combine and reduce the data-elements from the three reporting structures, the ‘vertical programmes’, the ‘PHC structure’ and the ‘APVVP’ (see figure 5-1). With less number of data-elements to report, it is argued that more accuracy is achieved.

6.3.2 Configuring DHIS

Together with the newly appointed database administrator for the project, I started working on further configuring DHIS. Our main focus was to configure DHIS with the new minimum data set, identify reports to be used with the application and finally populate the database with raw data from the primary health centres and the sub-centres.

We were left with the data-elements from the first Master student in the DHIS application. The plan was to convert already existing data-elements to match the mother and child health (MCH) form (also called ‘form 6’) data-elements. This form is issued by the department of family welfare and is one of the most important within health care in India. Analysis based on this report tells a lot
about the health status of the region, province, state and country. With health data related to ‘form 6’ we could quickly present raw and analyzed health data. This was important since we were contracted under the Department of Family Welfare, and thus it was important to get these data-elements registered quickly to demonstrate the flexibility of DHIS, i.e. mapping the paper form to the database. To accomplish the mapping we had to identify which data-elements that was already there and change the name to match the name on the form. This was relatively easy as we got help from the medical doctor from the HISP team. However, we did run into problems of incompatible data-elements between what was already there and what was on the ‘form 6’.

A problem arose when we were about to distribute the new minimum data set to the five primary health centres. Entering of data at the health centres was already underway, because of the pressure to show officials the value of the application, and so we had to retain the data from the five computers. As we stated this, we soon found out that the data-elements on the different computer were different from one other. Consequently, we had to go around to all the computers, collect data, and tell staff to hold the registration until we could make a new master database. This was very time consuming. First, it took us several days to get hold of all the data. Often there were power cuts and often the batteries did not work, so we could not do anything except to come back the next day. Other times, we had simple problems like not having the key to the computer-room. When we finally had collected all the health data and the various primary health centres, we could go back to Bangalore and do another round of name-mapping to build a new master database.

Another disability we faced was access to work on a computer. We were originally allowed (orally that is) to sit in the area hospital on the one computer stationed there, but that proved to be difficult. Other people worked on that computer, training and entering of data was going on there, and we had to get out when the man with the key closed at five o’clock. To let us borrow the key was not possible because of responsibility problems. As we found out that just about nothing could be done in Kuppam, we had to collect as much as possible of data in Kuppam, and then go back to Bangalore to work on a computer we had available there. A laptop or even a designated computer in the apartment would have solved a lot of problems earlier, but this was what we had to work with. There was very little we could do about it, except to try and make the best out of it.

When we thought we had a usable master database, we found out, when one of the coordinators visited, that it were missing about 200 data-elements, identified and agreed on at the last workshop. DHIS had been configured with this minimum data set, but all this had then been overwritten when representatives from Aptech was given the task to install an updated DHIS version. One can-
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not blame the people who did this, as they had been given little training and instruction on how to install the software. There were no instructions on where to put the back-end data and Aptech had no experience on how to run a project like this.

We then had to identify the mapping once again. But as entering had been going on in Kuppam, we had to make some functionality in Access that converted the data-element data from the old to the new. In addition to this, the ‘form 6’ schema was changed again, for the third time, so we had to make changes in the database again. A complete and correct minimum data set was implemented in DHIS and finally distributed to the five computers in May, after about four months of work.

Work on the reports was perhaps even more frustrating. We identified as many as 60 reports that were in use within the district. Every report was equally important when you got the explanation of the importance of the report. However, most of these reports are only for checking that persons do their job and the statistics were not used to monitor and improve health care in the area. Many of the reports used a mixture of names and statistics, so implementing these reports is not possible using DHIS.

A second major difficulty in implementing the reports was the lack of a stable minimum data set to relate to. As we were going through the reports, data elements were either missing or were differently defined in the minimum data set. It was not possible to change the format of the reports to correlate with the minimum data set in DHIS because the reports were official for the district. Adding data elements ad-hoc to the minimum data set would create a too large set to manage. This interdependency between reports and the minimum data set resulted in standardizing a final minimum data set and created the reports that were possible to make from this minimum data set.

After this move, some progress on the reports was made. An extra module in Access was made especially for Chittoor district. This module can print various reports and charts for various facilities within the health hierarchy. For example, ‘form 6’ report can be printed for the sub-centre and the primary health centre.

In addition to all these constraints, the project coordinator from the Indian Institute of Management in Bangalore refused the database administrator and a system developer to travel from Bangalore to Kuppam to work. His argument was that “programmers and should not run around in Kuppam and collect information”. The task of collecting information for the reports should be done by others in the HISP team, and the information should be handed over to the programmers in Bangalore. On my request they were allowed three days in
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Kuppam pr month for interviewing and testing purposes. However, this was still inadequate.

6.3.3 Clusters

Placing computers in every primary health centre was not feasible. First of all, HISP was not able to get that many computers from the Department of Family Welfare (although originally nine computers were sanctioned only seven were delivered). Second, it would be a waste of resources, as many of facilities had very unstable power supply. Other facilities were in such poor conditions that no computer could be placed there.

The idea to create a ‘cluster strategy’ came about because there were not enough computers available for the nine health centres. To deal with this highly relevant situation, computers where then placed at selected health centres based on communication, power supply, enthusiasm of staff etc.

An example of a good hub is Ramakuppam. This village has frequent bus connections to and from Kuppam, has (on paper) electricity 24 hours, it has two nearby primary health centres (Vijilapuram and Veeramala), it has a large staff where especially one field worker was very enthusiastic about working with computers. Using Vijilapuram would be an example of a poor hub. This very remote village has no direct bus connection and to travel to Kuppam takes hours. The facility building is poor, the power supply is very unstable and it has a small staff (see also figure 6-1 on page 49). Based on information like this we were able to pick out which facilities that could serve as a hub.

Six primary health centres got a computer and the last computer was placed in area hospital. Placing the computer in areas hospital was made so that field workers living in Kuppam could enter data and be trained there.

6.3.4 Organizational changes

One of HISP’s objectives is to decentralize the management and the flow of reporting within the primary health care sector (Braa 1997; Braa and Hedberg 2000; Braa et al. 2000). This is in line with the World Health Organization’s guidelines, which encourages decentralization as part of its primary health care strategy to strengthen health management at local level (WHO 1979). Although the primary health care structure embedded in India is in its nature built up in a decentralized way, the large gap between the primary health centre and the district headquarter (see figure 5-1 and table 6-2) makes the reporting structure very centralized. The reporting that is done at the primary health centres are done for 8 to 75 thousand people, while for the next step, at the district medical and health officer’s (DM&HO) office in Chittoor they handle registrations for 3.75 million people. Hence very little feedback is given from the
district back to the individual primary health centre, except some occasional reprimands for not fulfilling the immunization and sterilization targets.

Between my first and second visit to Kuppam the reporting structure changed to be more decentralised. A new reporting unit between the primary health centre and the district was introduced, thereby lowering the huge gap in population between these two. The two different structures do not vary much, and I will here only describe the previous and new structure.

The information flow mainly illustrated above can be divided into two main parts. The ‘PHC structure’ is there to support the mother and child health programs and various vertical programs. Below this, the health workers in the sub-centres collect health data on various programs and send it to the primary health centres that aggregate it and send it to the district office who do further aggregation across the different primary health centres and send it to the state.

The APVVP (Andhra Pradesh Vaidya Vidhana Parishat) is a separate structure recently established as part of a World Bank project to strengthen the hospital infrastructure. All district (200+ beds) and area hospitals (100 beds) and com-
Community health centres (30 - 50 beds) come under the purview of the APVVP. This involves a parallel and independent management and reporting structure flowing from the hospitals to the District Coordinator of Health Services (and not the district medical and health officer as in the first two cases) who in turn send the reports to the Commissioner APVVP (and not the Commissioner for Family Welfare or Director of Health as is the situation in the last two cases respectively).

Table 6-2 illustrates some data on the sizes and administrative leadership of the new and old reporting structure in Chittoor. The new reporting units are divisions and sectors. There have been established six sectors in Chittoor: three in Madnapalli division, two in Chittoor division and one in Tirupati division. For the most, the new units exist only on paper. In practice the reports are still sent directly to Chittoor, and thus one cannot say much about the effectiveness of this changeover yet.

<table>
<thead>
<tr>
<th>Administrative leader</th>
<th>Unit (new)</th>
<th>Unit (old)</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM/Secr. of health</td>
<td>State (Min. H&amp;FW?)</td>
<td>State (Min. H&amp;FW?)</td>
<td>75 million</td>
</tr>
<tr>
<td>DM&amp;HO</td>
<td>23 Districts</td>
<td>23 Districts</td>
<td>3.75 million</td>
</tr>
<tr>
<td>ADM&amp;HO</td>
<td>3 Divisions</td>
<td>1-1.5 million</td>
<td></td>
</tr>
<tr>
<td>MO</td>
<td>84 PHCs</td>
<td>84 PHCs</td>
<td>30 thousand</td>
</tr>
<tr>
<td>MPHA</td>
<td>Sub centre</td>
<td>Sub centre</td>
<td>5 thousand</td>
</tr>
</tbody>
</table>

Table 6-2: Administrative units in Andhra Pradesh and Chittoor

Even though the reporting structure has been reduced from three to two hierarchal levels it still represents a poor referral system. A patient can go to whatever primary health centre or hospital he or she wants to go to with the same problem. If the patient is displeased with the treatment in one primary health centre, he or she can go to another health centre or the hospital the same day. Thus the same illness would be registered twice.

HISP tried to push for change in reporting procedures within the district. The idea was to make the reporting unit between the primary health centres and the district work and in turn create a more local reporting structure. The problem is to find a suitable organizational unit that can function for this kind of task without to much extra resources being spent.

One option was to use the mandal offices (revenue offices) to be in charge, but this was turned down because they did not cover enough health centres and because these offices are not directly connected to health (their function is mainly to serve as a local revenue department). Another option was to use the revenue divisions and sub-divisions that each district is divided into. Chittoor has three divisions; Tirupati, Madanapali and Chittoor division, and some of these again are again divided into sub-sections. The divisions do not have any
building or a specific manager within the health hierarchy that can act as a reporting unit, so this has to be established more or less in an ad-hoc way. For example, to use the case from the pilot project, area hospital in Kuppam could possibly serve as a sub-division reporting unit. It has relatively stable power supply 24 hours day and frequent bus connections.

The overall problem with making these changes has been the problem of convincing the decision makers at all levels of the health bureaucracy. Let us begin at the top. The commissioner of family welfare was very reluctant to change any kind of reporting routines in the pilot area. First, this way of reporting is basically more or less how it is done throughout the rural areas in India, so it is hard to just change it. Even though this would only be for a fairly small part of a district, the reporting procedures are interconnected so making changes one place would effect others. I do not think they see the point of setting up a “virtual” reporting unit without any real function when the normal reporting procedure had to go on as usual. Second, assigning or reassigning people to the specific posts costs money for the ministry. A third reason for not changing any reporting procedures was given by the commissioner of family welfare herself. It was not possible for the department to handle three different kind of reporting systems simultaneously (the CMC-system being the second after the existing paper-based). It was probably also a reaction for feeling left out, as she had suddenly realized that HISP was deeply involved in Chittoor without her knowing about it. Irrespective of reasons, it ended in formal instruction to Chittoor, saying that no reporting procedures were to be changed, and that no support should be given to HISP.

At the middle level, the district medical and health officer’s office in Chittoor, the willingness to make changes was to an extent quite open, especially from the district medical and health officer himself. The only problem was that the district has to conduct itself to the department at state level, and can in theory do nothing without approval from the top. Thus, it was a noticeable setback when instructions of no support came from the department of family welfare. The district medical and health officer could do nothing more than say “sorry, I can’t help you anymore”, even though, as said; “[he] totally supported HISP”.

At the lowest level, the primary health centres and the sub-centres, some unwillingness to change was put forward. A few health-workers, when explained about the new way of reporting, expressed concern over not reporting directly to the district medical and health officer, which made them feel more important and their job more meaningful.

**District database in Chittoor**

To get an overview of the data at all the 84 primary health centres in Chittoor, a DHIS database was put up at the district medical and health officer’s office.
Data was then entered by HISP team members for the months of April through November 2002. This move was done for two reasons.

The first reason was a direct result of a question that was raised during the analysis of the data from the nine primary health centres (this analysis is given in chapter 7). The question was about the equality in the health data reported in DHIS was the same as health data reported through the paper-based system directly to Chittoor. Was the official numbers in Chittoor just as “bad” as what was discovered in the analysis? Having the two sources, one could easily check a primary health centre for a specific month or year to see if the reported figures were the same.

The second reason was more of a strategic one. It started to come apparent that running around the nine primary health centres in Kuppam was not giving enough influence and exhibition of HISP within the primary health sector. Setting up a computer and assigning people to the district medical and health officer’s office signalled that something was actually being done and gave HISP closer contact with the decision-makers in the district capitol. It was important to build up a stronghold in the middle of the hierarchy and thus having some sort of control and influence at the top (political influence in Hyderabad) in the middle (close contact with senior health officials in Chittoor) and at the base (support and feedback from the health workers).

6.4 Adapting DHIS to local requirements

As described above, computers were already stationed at primary health centres and entering of data was ongoing as part of the training programme, at the same time as local adoptions of DHIS were implemented (6.3). It would have been easier if one first could make these adoptions and then introduce the system in the five designated places, but the need to show results at an early stage pushed HISP to collect and enter data as fast as possible. The process of introducing DHIS at the primary health centres are therefore described in some relation with the adoption process as they both affect each other.

6.4.1 Problems encountered adopting DHIS locally

Validation rules

The first problem we discovered was the lack of understanding of the minimum and maximum fields in the registration form. The purpose of these two fields is to trap and to comment on abnormal values. For example if the values for ‘new born’ for a particular sub-centre is around 13 every month, the software will give a pop-up message if the entered number is 130, telling the user to check her typing again. If the number actually is 130 (i.e. much above the average), the field worker must make a comment to explain the abnormalities.
However, the way these two fields were used was to show the target number for the data-element. The minimum field was always zero and the maximum field was set to the number the field worker is supposed to achieve within a month. When I told the trainers that this is not the way these fields are supposed to be used, the reply was “…but the medical officer [at the primary health centre] said we should do it this way. He won’t agree to this. I can’t simply change this without his permission”.

Double registration

Another problem that appeared was double registering of health data. Health data from the sub-centres was first registered individually but then some already summarized data-elements were entered for the primary health centre. The numbers were then represented twice in DHIS because calculations between the aggregated levels are done automatically. Only numbers that are specific for the primary health centre should be registered, not for health centre and the surrounding sub-centres. When data for the primary health centre was entered into the application, the data was taken directly from the broad-sheet where data from the sub-centres had already been added up.

Data for the primary health centre had to be entered once again in many places and one had to find sheets that had numbers only for the health centre. It should be added that hardly any of the health data within family welfare are directly reported from the primary health centre, most of the data is collected at the sub-centre. Thus only a few elements would have had an impact on the analysis.

Poor education, ambiguities in the software and the ease of entering from the broad-sheets seem to cause the problem of double registration. It was the trainers from Aptech who entered these data and they were poorly educated in DHIS. Besides, it is not obvious that you should enter data only for the primary health centre, especially when you find the data already aggregated. As already mentioned, time constraints were pushing for fast data entry. Thus, using the broad-sheets directly instead of the other sources available speeded up the process significantly.

Hardware problems

There were several problems with the computers at the five primary health centres. One of them, and maybe the most humorous, was that rats had a peculiar liking for printers. The power cords to the printer and the inside of the printers were more than once eaten by rats in Kuppam. A common feature of the problems described below is that they all relate to electricity.

Electricity in Chittoor and Kuppam is very unreliable and there are frequent power cuts, even in places like V Kota, Ramakuppam and Area Hospital where
electricity is supposed to be 24 hours a day. The other health centres that have electricity at scheduled timings, often alternating every other week, are also unreliable. For example, a primary health centre can have power from 6 AM to 11 AM in one week and from 1 PM to 5 PM the other week. To deal with the power supply problem, every computer has a UPS (Universal Power Supply). This can keep the computer and monitor running for ten to fifteen minutes to end work and shut down the computer properly. An additional way to cope with the unstable electricity is to have external batteries connected to the UPS, extending the possibility to work without power for about two hours.

I experienced several problems related to unstable power supply. First of all, HISP did not know the timings for power cuts at the various facilities. After a while this issue was clarified but we still encountered power problems. The batteries and UPS often failed to support as a backup. Some UPSs simply broke down, as was also the case with the batteries. The batteries were often discharged because the staff at the facility disconnected the power after they had used the computer (a normal procedure at the primary health centre) and thus the batteries would not recharge. As a result of the wrecked UPSs and flat batteries, the computers were connected directly to the electrical pole. This again resulted in the breakdown of computers because of the poor voltage. The company vendor for the computers came and replaced the components the first times, but said after this had happened a few times that the warranty would not be valid until the voltage problem had been solved. It was decided not to use the computers at all until this had been done. Thus, the computers were not in use for about two and a half weeks.

It also became clear that vendor support in Kuppam is poor. It takes days, if not weeks before someone can come and fix computers. To get hold of equipment like printer cartridges is difficult. HISP has tried to handle these problems by making deals with local internet cafes and by hiring persons that can fix many of the hardware problems.

Local resistance

Especially in two primary health centres, members of the HISP team felt they met resistance towards the project. It was primarily the medical officers that expressed contrary viewpoints. Compared to the other facilities these two centres gave us the impression that they were working against the use of DHIS for registering monthly health data. Their critique was first and foremost directed towards the slow progress of the project. They could not see the value of the project and what good the project would do for them and the field workers. The two medical officers attended several training sessions, workshops and meetings with HISP team-members, so they had good knowledge of HISP’s goals and prospects on how to proceed forward. However, their critique can be understood.
In spite of how HISP theoretically might reduce time spent on reporting, the project has initially created increased workload for the health workers. Instead of using only the paper form, they have to register data three times. First the family welfare ‘form 6’ has to be filled in on paper. Second, the HMIS (Health Management Information System) form has to be completed before the field workers have to type the figures into DHIS as a third and final task. The data-elements in DHIS and ‘form 6’ are exactly the same, but DHIS has some extra elements that can be used. There are similarities between the HMIS form and DHIS – the name of the data-elements are different, but more or less they capture the same data. This redundancy makes the system very ineffective and creates extra work for the health worker. This situation is however a reality HISP has to relate to because the decision makers are not willing to give up the two other flows of information.

However, this is not the only reason why the two health centres developed indifference towards HISP. As described above, hardware problems were frequent at the health centres, and this was also the case in the two particular health centres. Thus, training and data entering had to be moved to the area hospital in Kuppam. Nonetheless, the field workers did not show up for training or to enter monthly data. When the computer was fixed, the medical officer decided that the responsibility for the computer should be put on the individual. Because of this decision, the computer was not used at all by the field workers because of the fear of damaging the computer. The project coordinator for HISP did not want to move the computer, arguing that the computer was placed there and therefore it should be used there. In her opinion, the medical officer made this decision to demonstrate power, and her reaction was to play hardball back.

At the other primary health centre, the problems were more or less similar, only not that harsh. The medical officer in this health centre wanted to place the computer in her office, claiming there was no room for it other places and that she wanted to look after the computer. She used the same argument of responsibility, but I find it hard to argue for space as we found lots of available rooms in this brand new health centre.

Other problems reported of social character were that many field workers had problems turning on and off the computer. They reported that they could enter data into DHIS, but did not know how to turn on the system. I find this to be a social problem, as I believe the field workers are more afraid of turning on the computer, and thus be blamed if the computer gets broken, than actually learning this simple task. It is also a good illustration of what level the trainers have to work on when teaching how to enter health data. Every step has to be taught, and nothing can be taken for granted.
Language

Another problem for the users is the language. In India there are more than twenty official languages, so standardization of a language is difficult. As India is a former British colony, English is still the official language after Hindi. However, many health workers do not speak or read English. The monthly data paper-sheet which is used for registration is in their local language, but DHIS is in English. To make this easier for those who enter the data, the order of data elements are in exactly the same order as it is on the paper form. This way, the users were able to scroll through the fields and most of them have no problem in assigning the right value to the right field. This also eliminates some misunderstandings like wrong spelling etc.

DHIS has now been translated into Telugu because Windows XP now has support for this language. It is however too early to report on the effects yet. It does, nevertheless, provide increased flexibility and the adjustability for local and global support of DHIS. The HISP team was glad they could answer yes when the President of India asked, after a short presentation, if the application was in Telugu too.

Inaccurate data entry

At a later stage when the field workers started to enter numbers themselves, a few observations were noticed about entering. In some cases a lot of the numbers for the same period entered were rounded numbers – they had a tendency to end with zero. This was especially the case with numbers entered for the primary health centres but also for some of the sub-centres. Another observation within this field was done by one of the trainers. Some field workers came without any diary or papers whatsoever to enter the data for a month. When confronted with this they said that they remember all the numbers in their head, something both I and just about every one of the trainers also found quite remarkable. A third example to support this indifference in registering the correct numbers appeared as we went to a primary health centre to collect some missing numbers for some particular data-elements. When asked about this, the health workers then asked for what month, and found the form for the month. However, the numbers we needed were not on the form, so she typed them in on the fly, quite bluntly. The final observation, which is within the same category, was done by fellow students of mine. When looking for particular numbers at another primary health centre they, after a bit back and forth, ended up having coffee and tea at a field workers house. When asked about the key to the door containing the forms and numbers, she just could not find out what could be so important about these numbers.

These four incidents altogether gave us the feeling that some field workers reported data indifferently. They seemed to be more concerned about reporting what authorities wanted to have, rather than registering actual numbers. This
problem is not directly linked with the DHIS application, but nevertheless it was discovered at an early stage through the use of DHIS. This problem might not be addressed because higher authorities are content with the inaccurate numbers. As long as targets are met and they can report “good” numbers to the institution above, they feel no need to question the numbers.

Reports
Very little of the reports that have been made are in actual use in the nine primary health centres. Still, there are no wall graphs and no printouts of the numbers at the primary health centres. Some health centres have printers but they have not been used (when in order) to these kind of tasks yet. Indicators are not being used neither at the primary health centres nor the sub-centres in any comprehensive way.

Still, the medical officers prefer to use the paper based system, even though it is possible to print reports directly from DHIS. The hardware problems already mentioned is one reason why this is not being utilized yet, but there is one other reason as well. It is easier to fix the numbers on the paper-form for the primary health centre, than it is in DHIS for the sub-centres. As one medical officer told us when asked why she did not use the computer to generate reports: “If the value is 5, it must give 7” referring respectively to the input and report output. The printout for a primary health centre summarizes the numbers from the sub-centres and primary health centre and generates the ‘form 6’ report. Under or over reporting would need to be done consistently over several units, and not only at the primary health centre. The cumulative column for the fiscal health year is also something that is correct summarized in the generated DHIS report, something that is not always correct in the paper based reports.

However, issues pointed out in the analysis in chapter 7 below to respective health centres have resulted in changes at those places. For example, some figures have sunk significantly only a short time after questions were asked about the abnormalities. Hence, local level analysis and reporting has an impact and can influence health data registration, which again can lead to an improved public health service.

Data flow
It has not been possible to send the registered data with floppies or CD-Rs as a monthly routine. A few reasons why this has not happened are worth mentioning. First, the poor support at the district has made it difficult to deliver the data there. A computer is available at the district, but no person is appointed to operate DHIS there. Sending data to any other location would be unnecessary as official reports go directly from the primary health centre to the district. Second, many of the field workers cannot export and copy the data to a floppy yet.
Third, floppies have proved very unreliable and CDs have not been provided to the facilities yet. And finally, there is no support from the Family Welfare Department to do this transition, and thus nothing can be done at the primary health centres or at the district.

6.4.2 Successes

For some time it was difficult to see the positive sides when implementing DHIS in Kuppam. One the one hand, one primary health centres were doing well in the start entering health data into DHIS; the field workers could operate the computer (i.e. turn it off and on and start the application), they entered health data every month and they all had a positive attitude towards using DHIS, and with great support from the medical officer. On the other hand, two other health centres were doing average and the remaining seven had a poor start and did not show much result.

Data-entering

However, in the long term, one could see some signs of progress. Most of the health centres did better in entering health data. After some time only two or three health centres were struggling with entering data on a monthly basis and most of the others are did well. Within August 2002, data for 2001 had been entered and it was possible to do analysis of the data collected (such an analysis is given in chapter 7). As the project was ongoing up until 2005, most field workers came every month to the primary health centre to enter data, without much support from HISP.

Empowerment

Empowerment of health workers at grass-root level is an important goal for HISP. Seen from a strictly health related view, HISP argues that empowerment of field workers who register health data would lead to more correctly registered health data, that again would lead to better health for the people. Another view is to see the empowerment of health workers as start for empowering the rural community. However, to say if someone has been empowered or not depends on how you define this popularly used term. Nonetheless, in the simplest term, the signs of empowerment seen so far have mostly been limited to independent work on computers, e.g. some made their own schedules on Excel, someone started using Word etc., and very doing simple analysis and graphical presentations of data from DHIS. Some field workers and staff who took early initiatives in using the computers from start have made good progress and can use the application quite well. These people started to assist other users in DHIS and act as local ‘super users’ at the health centres. Further on, these health workers made demonstrations of the software for politicians, health officials and NGOs at various workshops, and to a certain extent they participate in the debate on the concepts of HISP.
An example to illustrate the empowerment of field workers can be taken from a workshop in Hyderabad. One medical officer, one health supervisor and six field workers attended. First they presented different aspects of HISP and later they answered questions from the audience in a frank and bold way. For the health workers, it was a great experience to travel to Hyderabad and meet senior officials and politicians. This is an example of how ‘grass root health workers’ can influence and boost their self-confidence.

Local initiatives

Although not directly connected to DHIS, it is fair to say that HISP has contributed to attract know-how to Kuppam. A relatively small rural place like Kuppam cannot display a large amount of educated people within the fields of software and hardware engineering, as they are drawn to the money in the multinational companies in Bangalore and Hyderabad. In contrast, HISP and other projects in Kuppam have managed to draw attention to this town through its research and development projects, and thus encouraged the locals to stay in Kuppam. People from outside the constituency are also drawn into the town. In the case of HISP, two system developers, originally from the Indian Institute of Management in Bangalore, have been working in Kuppam, whereas one now is working as a database administrator full time for HISP. Several people with a background in computer science have been employed to train the field workers and one has been employed to take care of hardware problems.

HISP also started collaboration with one of the two local private computer education institutions in Kuppam. Working with Aptech, HISP got tied up with a local learning institution that had knowledge on how to teach computer illiterates in their local language. The institution also had computers and rooms available for meetings and training that created a base camp for the project. This also created, as a secondary factor, footing for HISP within the community on a more personal and social oriented level.

6.5 CMC collaboration

This section describes in short terms the involvement I had with CMC Ltd. in Hyderabad. CMC is a software company that are developing a name-based health information system for the family welfare department in Andhra Pradesh, first called the India Health Care Project, but has now been renamed Family Health Information & Monitoring System (FHIMS).

This project started out as a World Bank sponsored project to develop a system for handheld computers (PDA) that can be used by field workers to register primary health care data. Instead of registering data monthly like DHIS does, FHIMS identifies the persons uniquely and registers information directly on
that person. This mean that one for instance can track an infant and see what kind of immunization that unique infant has received, and more important has not received, just as in modern western health care systems. The project has enjoyed good support from politicians and is still ongoing.

The FHIMS application uses the Multipurpose Household Survey (MPHS) database for unique identification. This is a huge citizen database containing over 76 million individual records.

### 6.5.1 FHIMS pilot

A pilot of this project was conducted in a district called Nelgonda, some three hours drive south of Hyderabad. The PDA part of this project failed considerable because of the complexities of dealing with 4 to 9 thousand inhabitants on one single PDA. Memory problems and the immense task of updating the MPHS database are the two major reasons for why the PDA part of the project was abandoned. For some sub-centres, almost 50% of the information in the MPHS database had to be corrected and updated.

However, what can be described as a success with FHIMS was the use of the software installed in the primary health centre and particularly the creation of immunization schedules for the field workers. Prior, the field workers had to go through their diary to find out when and what kind of immunization an infant is to receive (the mother has an immunization card also). Now, with the FHIMS software, a schedule is made for the field worker on which infants should receive immunization vaccine for the next month on a paper form. The system that is implemented now, concentrates on the immunization module of the software and instead of using PDAs, a paper-form is used to write down the names of the infants. Two times a month, the field workers should come to the primary health centre with the forms that are then entered into the database, and the field workers receive a new schedule.

### 6.5.2 Collaboration with HISP

HISP wanted to collaborate with CMC to get access to the health data in the IHCP database and populate the data into DHIS. The argument is that these two systems complement each other on their strengths and weaknesses and thus together they create a powerful tool for capturing primary health care data. In theory, the data on immunization would be more accurate and entering is only done once.

The process of developing a tool for automating the population-process from FHIMS to DHIS has taken a very long time. When a system developer and I went to Hyderabad to test out and try to create such a tool, we received poor support. CMC did not want to collaborate with us because they think of the two systems as competing, but were nevertheless forced to because of political
reasons. We started out with getting involved in budget discussions (in which I had nothing to say naturally) and ended getting a printout of the table-structures of the database. This was of course not sufficient information to create what we came for. Request for an office and a computer with software on, help from programmers at CMC etc. was promptly denied. All we ended up with was some experience on how to create the tool and a very early prototype that has never been tested.

In later stages, more pressure has been put on CMC to collaborate with HISP on integrating the two systems. This has resulted in giving a team of students from Oslo an assignment (within a course) to make such an integration tool (in which I acted as a coordinator). Though the students and I struggled to a degree on creating this integration tool, the outcome was a working prototype which was demonstrated to both project-leaders at CMC and the Family Welfare Minister in May 2003. The response was positive from both parties, and plans were under way to work further on integrating the two systems. Hence, HISP has got renewed support from the family welfare ministry and had broadened its network by collaborating more closely with CMC.

6.6 Summary

This chapter started with an introduction on how HISP started up in Kuppam and ended in describing further expansion of the project which is already ongoing. I have thus been involved in a wide range of problems on both a vertical and horizontal level.

Infrastructural problems, local resistance and bureaucratic issues are problematic in themselves, but interconnected they magnify each other even more. Thus it has been difficult in adapting and customizing HISP to the Indian context. Bureaucracy has influenced how training is conducted, on how DHIS should be configured, how organizational changes should be done, and how an expansion of HISP should be conducted. Local resistance have been magnified because of infrastructural problems and bureaucracy. Infrastructural problems have affected how training and system development have been conducted.

The overall success of the project so far has the ability to “stay alive” for almost two years and a small expansion within the state to two other districts. This may sound like quite limited successes, but HISP has made good progress compared to other health information system projects in Andhra Pradesh. The result of this has been that the HISP network has grown larger, covering local trainers to highly influential political leaders in the state.

The next chapter will analyze the health data captured by DHIS.
7 Analysis of Health Data from the Pilot Area using DHIS

This chapter will highlight some of the findings and problems found, using health data captured in DHIS in Kuppam. The first health data from the pilot area has been entered into the DHIS software and this chapter presents a quantitative analysis in combination with observations and interviews. This analysis has made it possible to assess the “official” numbers against the reality on the ground. The analysis is part of a report prepared in collaboration with another student of the HISP India team.

The chapter is divided into two areas. First, we look at some important performance indicators used by the Department of Family Welfare. Second, a grass-root level analysis is done of the data collected. In this way we try to develop implications for understanding health data quality in Kuppam. The health data is mainly collected from the nine primary health centres and their respective sub-centres. Census data, and in some cases household data, from 2001 is used to calculate indicators.

As described in section 5.1, most of the primary health care data is collected at the lowest level in the health hierarchy, the sub-centres. At this level, data is not stored, maintained or analyzed in any systematic way. Data is aggregated at each level and cannot be traced systematically back to its origin. This is a general problem and we will focus on how data can be disaggregated by using an IS like DHIS.

7.1 Population data and indicators

7.1.1 Population figures

We also emphasize problems with the population figures. There are three different sources that can be used when calculating indicators in Chittoor:

The census: official census for India, updated every 10 years through surveys.
The household register: population data collected by health workers at the sub-centres. Collected by the HISP team at the primary health centres for the purpose of this analysis.
The Multipurpose Household Survey: a population database conducted by revenue officials.

The census data reports a population about 15% higher than the other two. All of the three sources report different figures, and the census is regarded as the most accurate source. The household register is used to set targets; the larger population, the greater workload. The Multipurpose Household Survey population is used for allocating funding to the different revenue zones; the larger population, the more funding. The Multipurpose Household Survey also includes people that have emigrated and want to remain in the jurisdiction in order to maintain their right to vote. The health workers only count those who actually live there. These issues are undoubtedly influencing the population figures, and the quality control of the population figures must improve. We have tried to find several sources on the Internet, but there is almost only data for state level available.

7.1.2 Targets

There are two different targets used in Chittoor:

Objective targets: targets set according to population, e.g. children up for immunization; the target for “fully immunized infants” is set based on number of live births.

“Work-harder” targets: targets originally set by the Department of Family Welfare for the district (Chittoor). The District Collector distributes the targets to the primary health centres and raises the targets to make sure they are reached. Sometimes the Joint Collector and Medical Officers also raise the targets. When the sub-centres finally get these targets they are often too high to reach.

7.1.3 Indicators

Below we present the two types of reporting used for measuring the health status in Chittoor; one representing the Family and Welfare Indicators, the other is called the HMIS (Health Management Information System) indicators. Family and Welfare targets are estimated based on surveys and previous year’s registration. These indicators represent what the institutions (sub-centres, primary health centres, districts etc) are supposed to achieve according to the population in the designated area. HMIS indicators are performance driven, and set administratively by state and district officials. These targets embody the “work-harder” targets described above.

7.1.4 Family Welfare indicators

In table 7-1 we have filled in the actual numbers for Kuppam pilot area (average for all nine primary health centres from January 2001 to December 2001)
and compared them with the parameters for preparing micro level action plans (targets) set by the Department of Family Welfare in Hyderabad.

<table>
<thead>
<tr>
<th>SL No</th>
<th>Indicator name</th>
<th>Actual</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No of village level ANC/Immunizations clinics</td>
<td>As pr local sub-centre requirements</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>a) Ante Natal Cases registered (Total)</td>
<td>17.68</td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) Ante Natal Cases registered less than 12 weeks</td>
<td>8.37</td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>c) Total no of high risk pregnant women treated</td>
<td>3.75</td>
<td>3.75 AN Cases /1000 Pop</td>
</tr>
<tr>
<td>3</td>
<td>a) No of pregnant women who had 3 check-ups</td>
<td>25.11</td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) No of pregnant women counselled for nutrition</td>
<td></td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>c) No of pregnant women given 2 doses of TT</td>
<td>16.26</td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>d) No of pregnant women given 100 IFA tablets</td>
<td>15.11</td>
<td>25 AN Cases /1000 Pop</td>
</tr>
<tr>
<td>4</td>
<td>Total no of deliveries</td>
<td>16.63</td>
<td>22.5 Deliveries /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>a) Deliveries at primary health centres</td>
<td>2.51</td>
<td>3 Deliveries /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) Deliveries at other Govt hospitals</td>
<td>2.63</td>
<td>6 Deliveries /1000 Pop</td>
</tr>
<tr>
<td></td>
<td>c) Deliveries at private clinics</td>
<td>1.02</td>
<td>5 Deliveries /1000 Pop</td>
</tr>
<tr>
<td>5</td>
<td>a) No of women who had 3 post-natal check-ups</td>
<td>19.71</td>
<td>22.5 PN Women / 1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) Number of RTI/STI cases treated/referred among women</td>
<td>11.87</td>
<td>3.17 cases / 1000 Pop</td>
</tr>
<tr>
<td>6</td>
<td>Maternal Deaths recorded</td>
<td>7.07</td>
<td>1.54 / 1000 live births</td>
</tr>
<tr>
<td>7</td>
<td>No of live births (total)</td>
<td>93.33</td>
<td>95%-97% of the deliveries</td>
</tr>
<tr>
<td>8</td>
<td>a) No of high risk new born treated</td>
<td>0.52</td>
<td>10% of the new born</td>
</tr>
<tr>
<td></td>
<td>b) No of parents counselled for low births weight babies</td>
<td></td>
<td>37.7% of the parents of the new born</td>
</tr>
<tr>
<td>9</td>
<td>Children given immunization (below 1 year - Full immunization)</td>
<td>16.45</td>
<td>20 Infants / 1000 Pop</td>
</tr>
<tr>
<td>10</td>
<td>a) Measles cases treated</td>
<td>1.20</td>
<td>(blank)</td>
</tr>
<tr>
<td></td>
<td>b) ARI cases treated</td>
<td></td>
<td>31% of the 0-5 yrs. Children</td>
</tr>
<tr>
<td></td>
<td>c) Diarrhoea cases treated</td>
<td>2.69</td>
<td>25% of the 0-5 yrs. Children</td>
</tr>
<tr>
<td>11</td>
<td>a) Child deaths recorded infants</td>
<td>2.62</td>
<td>66/1000 live births</td>
</tr>
<tr>
<td></td>
<td>b) Child deaths recorded - children (1-5 years)</td>
<td>1.21</td>
<td>21/1000 live births</td>
</tr>
<tr>
<td>12</td>
<td>a) Number of marriages recorded</td>
<td>2.74</td>
<td>8 / 1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) Marriages where age of wife is above 18 years</td>
<td>0.58</td>
<td>3 / 1000 Pop</td>
</tr>
<tr>
<td>13</td>
<td>a) No of sterilization</td>
<td>9.56</td>
<td>12 / 1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) No of male sterilization</td>
<td>0.03</td>
<td>2 / 1000 Pop</td>
</tr>
<tr>
<td>14</td>
<td>a) IUD insertions</td>
<td>6.12</td>
<td>4.62 / 1000 Pop</td>
</tr>
<tr>
<td></td>
<td>b) Oral pills users</td>
<td>3.42</td>
<td>3.96 / 1000 Pop</td>
</tr>
</tbody>
</table>

\(^1\) Data for both sub-center and PHC
\(^2\) High number because of outliers and possible typing errors. Eliminating outliers indicates Maternal Deaths recorded to 1.44 pr thousand live births
\(^3\) Assuming one cycle every month, so number is divided with 12
c) Nirodh users 8.89 / 1000 Pop
15 No of high risk maternal cases referred to FRUs 3.75 / 1000 Pop
16 No of high risk children referred to FRUs 2 / 1000 Pop
17 High risk pregnant women 5.99 15% of the AN Cases
18 Institutional deliveries (Targets) 37.03 60% of the total deliveries
19 Deliveries at primary health centres 40.71 21% of the institutional deliveries
20 Deliveries at other Govt Hospitals 42.75 42% of the institutional deliveries
21 Deliveries at private clinics 16.54 37% of the institutional deliveries
22 Live Births 93.33 95% to 97% of the Deliveries
23 Still births 1.85 3%-5% of Deliveries
24 High Risk New Born 10% of the New Born
25 Low birth weight babies 8.10 37.7% of the New Born
26 Marriages where age of wife is under 18 years (Target) 21.23 60% of total marriages
27 Maternal Cases referred to FRUs 15% of the AN cases (High risk cases)
28 Children treated at FRUs 10% of the live births (High risk New Born)
29 0 - 3 years children 7.04 8% of the population
30 0 - 5 years children 11.44 13% of the population

<table>
<thead>
<tr>
<th>Table 7-1: Family Welfare indicators, January 2001 to December 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally, referring to table 7-1, the actual calculated indicators are lower than the targets set, and when comparing across the indicators other there are several contradictions. E.g. comparing ‘total numbers of deliveries’ (16.63 pr.1000/pop) with ‘number of women who had three check-ups’ (25.11 pr. 1000/pop), we see that total numbers of deliveries are much lower than women who had three check-ups. If this were the actual case, there must have been a large amount of abortions or unregistered births. Another contradiction appears when adding live births (93.33) with still births (1.85). Almost 5% of the births are unaccounted for; in this case 256 births are unregistered. In order to examine these contradictions and indicators further, one need to be able to disaggregate data to a grass-root facility level. In sub-section 7.2 we provide such an analysis.</td>
</tr>
</tbody>
</table>

Two more comments to table 7-1:

1. The indicators 4a, b and c have the same names as indicator 19, 20 and 21. Although the former displays in pr 1000 and the latter in percentage, it can cause confusion.

2. In the cases where the actual number is blank, we were not able to find data elements to calculate indicators in DHIS. Either the HISP team has not been aware of these indicators, or they are obsolete and were left out when defining the Minimum dataset.

---

5 Same as footnote 3
6 Data for both sub-center and PHC
7 Original indicator name is ‘Marriages where age of wife is over 18 year’. Only available data element was ‘under’
7.1.5 HMIS indicators

An approach used to evaluate the health service in Chittoor, is grading the primary health centres according to targets set. The grading system is binary, and as long as the figures are above the targets, they receive 10 points, if not they get 0. The numbers are then summarised, and if the sum is above a certain number, they get the best grade (A). The other grades given are B and C. The results are presented in public, through the District Collector’s monthly review meeting where all the Medical Officers of the district are present in front of the District Collector. The “good” primary health centres are praised, while the “bad” ones are reprimanded. The raw data for the HMIS indicators are registered and calculated on a weekly basis. They are monitored by the District Collector every week who then again present the data to the chief minister every 15th day through videoconference meetings.

Table 7-2 presents the HMIS indicators for eight of the nine primary health centres in Kuppam.
### Analysis of Health Data from the Pilot Area using DHIS

#### Name of The Sector Kuppam Sector

<table>
<thead>
<tr>
<th>SlNo</th>
<th>Name of the PHC</th>
<th>OP census</th>
<th>Lab Test</th>
<th>Sterilisations</th>
<th>Deliveries</th>
<th>AN Registration</th>
<th>Fully Immunisations</th>
<th>BS Collection</th>
<th>No of B.S Positives</th>
<th>No. Of Deaths due To Malaria</th>
<th>T.B Sputum Collection</th>
<th>TB Under Treatment</th>
<th>TB cured</th>
<th>No. Of GE Deaths</th>
<th>Catract Cases</th>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gudupalle</td>
<td>160</td>
<td>0</td>
<td>8</td>
<td>11</td>
<td>15</td>
<td>9</td>
<td>30</td>
<td>0</td>
<td>16</td>
<td>20</td>
<td>20</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>Mallanur</td>
<td>75</td>
<td>0</td>
<td>7</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>25</td>
<td>0</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Veemamallla</td>
<td>148</td>
<td>0</td>
<td>11</td>
<td>26</td>
<td>18</td>
<td>16</td>
<td>50</td>
<td>0</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>Paipalem</td>
<td>502</td>
<td>45</td>
<td>37</td>
<td>76</td>
<td>75</td>
<td>50</td>
<td>531</td>
<td>0</td>
<td>10</td>
<td>50</td>
<td>20</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>5</td>
<td>Rallabuduguru</td>
<td>2833</td>
<td>546</td>
<td>21</td>
<td>43</td>
<td>30</td>
<td>45</td>
<td>340</td>
<td>0</td>
<td>49</td>
<td>70</td>
<td>70</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>6</td>
<td>Ramakuppan</td>
<td>5067</td>
<td>281</td>
<td>31</td>
<td>27</td>
<td>7</td>
<td>25</td>
<td>297</td>
<td>0</td>
<td>41</td>
<td>60</td>
<td>60</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>Sanhipuram</td>
<td>92407</td>
<td>590</td>
<td>23</td>
<td>46</td>
<td>45</td>
<td>49</td>
<td>335</td>
<td>28</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
<tr>
<td>8</td>
<td>V Kota</td>
<td>7574</td>
<td>0</td>
<td>64</td>
<td>108</td>
<td>112</td>
<td>52</td>
<td>359</td>
<td>13</td>
<td>21</td>
<td>42</td>
<td>80</td>
<td>B</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>C</td>
</tr>
</tbody>
</table>

Table 7-2: HMIS indicators
The targets are the same for all primary health centres. Workload, size of population etc. are not taken into account when setting the targets; so how are the targets set? They are, as said, set by health officials and bureaucrats, but on what premises? It is our understanding that only health officials and the local administration in the district follow up sterilization achievements for the HMIS indicators. There is a need, we believe, for these targets to be analyzed closely in relation to the local achievements. More realistic targets can thus be calculated through a participatory process involving local staff. In this way, the targets would be seen as achievable, and serve as a point of motivation. Currently, the general feeling at the facilities towards these targets is that they “are merely numbers that can never be achieved anyway”.

The data is not converted into indicators and are therefore not comparable, since the size of population varies significantly across health facilities. The data cannot systematically be traced down to sub-centre level to find out where there is need for improvement in the health status. Grading might to some extent improve performance for the primary health centres and sub-centres by forcing health staff to work harder, but it might as well lead to manipulation of numbers. However, grading does not help us understand the problems at grassroots level.

7.2 Data analysis

This section will describe the analysis done for health data collected for the year of 2001 for the Kuppam pilot area. This data was collected using “Form 6” (Family Welfare form for collecting mother and child health data), the field workers’ diary and broadsheets at the primary health centre level. Computer professionals and field workers in collaboration did the data entry part from April to July 2002. The objectives of this analysis are to show how it is possible to improve the health standard by using indicators that are drilled down to the sub-centre level.

The analysis is divided into five key areas: Lab tests, fully immunized, ante natal care, maternal and infant mortality rate, and life cycle events. These are important indicators in the area and are used extensively in family welfare planning. Almost all of the health facilities show either discrepancies among the data collected or data that does not match with reality. At this point we are only able to indicate possible questions regarding the issues we present. These questions need to be systematically investigated and addressed to improve the health in the district.
7.2.1 Lab tests vs. patients seen

<table>
<thead>
<tr>
<th>Name of primary health centre</th>
<th>All lab test other than Malaria test</th>
<th>Malaria blood smear collected</th>
<th>Total headcount (OP, ANC, IMM, etc)</th>
<th>Population data</th>
<th>Total headcount/ Population data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallanuru</td>
<td>38,731</td>
<td>37,174</td>
<td>1.042</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paipalem</td>
<td>26,570</td>
<td>66,448</td>
<td>0.400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rallabuduguru</td>
<td>820</td>
<td>15,896</td>
<td>24,507</td>
<td>0.649</td>
<td></td>
</tr>
<tr>
<td>Ramakuppam</td>
<td>0</td>
<td>51,211</td>
<td>26,865</td>
<td>1.906</td>
<td></td>
</tr>
<tr>
<td>Sathipuram</td>
<td>922</td>
<td>1,086</td>
<td>30,869</td>
<td>50,885</td>
<td>0.607</td>
</tr>
<tr>
<td>V Kota</td>
<td>3,900</td>
<td>87,190</td>
<td>74,750</td>
<td>1.166</td>
<td></td>
</tr>
<tr>
<td>Veernamalla</td>
<td>6,925</td>
<td>8,714</td>
<td>0.795</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vijlapuram</td>
<td>27,804</td>
<td>14,302</td>
<td>1.944</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gudupalle</td>
<td>1,408</td>
<td>26,156</td>
<td>38,376</td>
<td>0.682</td>
<td></td>
</tr>
</tbody>
</table>

Table 7-3: Comparison of outpatients – lab tests – Malaria blood smear collected

There should be some correlation between number of lab tests carried out and number of patients seen by the doctor (total headcount). As we can see, there is no correlation and lots of missing data. We cannot make a conclusion with such a small sample of data, other than that the registration needs to improve dramatically!

Not being able to say anything about these correlations, we looked at the population data to compare with the Total Headcount. The last column clearly point towards a lack of correlation. The huge differences can be caused by immigration of people and through erroneous reporting. The idea is that all primary health centres should have the same standard and provide the same services, but this is not the case amongst the primary health centres in Kuppam. Good quality primary health centres are naturally used more than poor ones, but the registration procedures are not able to capture this. The workload will therefore vary heavily on the different primary health centres, and that should be kept in mind when allocating resources.

The last column in table 7-3 indicates the number of visits pr capita pr year at the primary health centre. We see that the ratio is quite low; and average of about one visit pr year pr person. We also noted the quite large difference in the ratio between the primary health centres, varying between 0.4 and 2.

7.2.2 Fully immunized

An infant (from birth to one year) is categorized as “fully immunized” as soon as she or he has received the vaccines BCG, OPV1-3, DPT1-3 and measles. ‘Infants given vitamin A’ is newly introduced, and cannot be taken into account, since data is lacking. BCG is given right after birth, OPV1-3 and
DPT1-3 the following months and finally the measles vaccine is given at ninth month of age (table 7-4).

<table>
<thead>
<tr>
<th>Age</th>
<th>BCG</th>
<th>OPV 0</th>
<th>Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td></td>
<td></td>
<td>Tuberculosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oral Polio Vaccine (Zero dose)</td>
</tr>
<tr>
<td>6 weeks</td>
<td>OPV 1</td>
<td>DPT 1</td>
<td>Oral Polio Vaccine (1st dose)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Diphtheria</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whooping Cough</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tetanus</td>
</tr>
<tr>
<td>10 weeks</td>
<td>OPV 2</td>
<td>DPT 2</td>
<td>Oral Polio Vaccine (2nd dose)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Diphtheria</td>
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<td></td>
<td></td>
<td></td>
<td>Whooping Cough</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tetanus</td>
</tr>
<tr>
<td>14 weeks</td>
<td>OPV 3</td>
<td>DPT 3</td>
<td>Oral Polio Vaccine (3rd dose)</td>
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<td></td>
<td></td>
<td></td>
<td>Diphtheria</td>
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<td></td>
<td>Whooping Cough</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Tetanus</td>
</tr>
<tr>
<td>9 months</td>
<td></td>
<td></td>
<td>Measles</td>
</tr>
</tbody>
</table>

Table 7-4: Immunization schedule for infants (WHO)

This should give a few logical facts:

The number of ‘live births’ conducted and ‘BCG vaccine given’ should have roughly the same numbers.

OPV1 and DPT1 are generally given at the same time and we should therefore theoretically see a correlation between these numbers (the same is of course the case with OPV2, DPT2, OPV3 and DPT3).

Measles vaccine should be lower than all the other vaccines given, because of child deaths.

When a child gets the last vaccine, measles, it is considered to be fully immunized. Common practice among most of the health assistants is to tick of ‘fully immunized’ at the same time as the last vaccine (measles) is given. This does not follow the logic naturally, as the infant can receive the measles vaccine and not any of the other vaccines, and thus not be fully immunized according to the definition.

Finally, the overall picture should result in a small decrease along the time span the vaccines are given. Infants given full immunization (and measles) should have the lowest number on the graph.

Figure 7-1 demonstrates that the logical path described above does not match with the registered data. In more detail, ‘Number of live births’ is the lowest number on the graph, while at the same time, registered BCG vaccines are almost a thousand more than the number of live births. DPT1 and OPV1 do not correlate at all, and from OPV-1 to fully immunized, the numbers actually increase. We also see quite clearly that the numbers do not match the estimates
and targets calculated using census data from 2001. The actual numbers vary from 15 to 28 percentages below the estimated targets.

Figure 7-1: All immunization vaccines for infants, leading to fully immunized infants. The estimates are calculated using the census 2001 and the targets given in Table 7-1.

Furthermore, comparing number of infants from the 2001 census with BCG vaccines given, we get BCG coverage of 98% (except Gudupalle). This is a good coverage, which might indicate that BCG is a prioritized vaccine among both health workers and mothers. Calculated by using live births as denominator we get BCG coverage of 118%. This indicates that women that give birth are not reached by the health workers. BCG is, besides reflecting the proportion of children who are protected against the severe forms of tuberculosis during the first year of life also an indicator of access to health services (WHO). Could BCG be over-reported to show that health service access is available at the particular sub-centre?

Using the census, we see who receive health services, and in this case only 70% of the live births are registered. Thus, we see that 30% are not reached by the health service. These data are also reflected in the other figures.

Data regarding the path to full immunization can also indicate that the registered data are wrong due to under-reporting, or estimates and targets are simply set to high by the health department. The reason may also be that the health workers are not doing their job properly, or lack of DPT and OPV vaccine. BCG and measles are rarely out of stock.

Comparing the numbers of registered births for the whole year with estimated infants in the area from the 2001 census, should give a pinpoint on the immu-
nization coverage in Kuppam. The percentage, using census data, is calculated with the formula given in equation 1. To compare the census’ ‘infants less then 1 year’ data with what the health workers actually register, we use ‘live births’ as a denominator. Though one cannot compare these directly (because it is nine months between live births and fully immunized) it still gives an idea on the difference of using two population sources (if one assumes an equal flow of live births over the years). The graph does not give a totally correct picture of the coverage, for that one would need a complex name-based system to follow each individual infant. But it does give an overview of the situation, and that is what we want in the first run.

\[
\text{%coverage} = \frac{\sum \text{(Registered fully immunized)}}{\sum \text{(Infants less than 1 year from census)}} \times 100
\]

Equation 1: Calculation of immunization coverage

Figure 7-2: Immunization coverage at primary health centres, no census data available for Gudupalle

Figure 7-2 illustrates the immunization coverage across the nine primary health centres in the Kuppam area. We have used two different sources as a denominator, the census data and live births. Calculated for all primary health centres, using the census data, the coverage is average 83%, which is fractionally below the 85% WHO recommends. Paipalem, Santhipuram and Vijlapuram have coverage above 85% (using census data), while the other five are well below the recommended coverage.
The difference between using census and registered live births are clearly demonstrated. Every primary health centre is well above 90% coverage when using ‘live births’, for one year, as denominator. Some of the primary health centres are also well above 100%, e.g. Mallanur, indicating either over-reporting of fully immunized infants or live births not registered. The last indication (live births not registered) would be most likely when we compare with the coverage calculated using the census data.

Again it comes down to what numbers that are used as denominators. We have seen how much difference it makes by using two sources, census data and registration done by the field workers (service given). The census data is known for being the most reliable source, and what we use to calculate the health service coverage, but one cannot simply rule out other sources. Besides, census data have not been used until recently for comparison and making indicators within primary health care, which demonstrate the irregularity in the numbers available at local level.

7.2.3 Ante natal care – check-ups

Pregnant women are registered and are offered the possibility to go to check-ups during the pregnancy, to make sure they are in good health etc. We looked at the number of women given 1st, 2nd and 3rd check-up, TT-1, TT-2 and numbers of deliveries conducted. TT-1 (Tetanus toxoid) should correspond to the 1st check-up and TT-2 to the 2nd check-up, since the vaccines habitually are given at the same visit to the health centre.

First, we looked at data for the whole pilot area (figure 7-3). The number of ante natal care (i.e. pregnant women) check-up, increases for each check-up, even though one are not supposed to receive the 2nd check-up without having the 1st check-up. In the case of ante natal care check-ups, there is an increase of 35% from the 1st check-up to the 3rd for the whole pilot district. This can indicate that the data is wrong, or that 4th, 5th and so forth are registered as the 2nd and 3rd check-up, indicating a misunderstanding amongst some of the health workers in using the data-elements.

In figure 7-4 we look at all the primary health centres individually. There are huge discrepancies between the different data elements, and we easily see that it is particularly one primary health centre that stands out, both in correspondence across the two check-ups, but also the increase in the ante natal care check-up cases.
Paipalem primary health centre’s numbers for the 3rd check-up is 68% higher than the 1st check-up! Why is it like this, and why is it only Paipalem that has such abnormal data? One reason might be that field workers are giving ante natal care check-up, while TT is given at the primary health centre. The numbers should normally correlate with each other, but having data from two different sources, it is more likely that errors will show up. Another reason might
be that ante natal care check-up is not done three times by the field worker, but several times depending on the primary health centre. If the reason is because of misunderstanding the data-elements, field workers at Paipalem primary health centre, need to be informed.

The paper-based collection are forwarded up in the health system and aggregated at each level. The ability to detect or follow up localized anomalies is lost as aggregation obscures such discrepancies. Using an IS like DHIS that can perform analysis at a disaggregated level, can help to easily locate such abnormal data.

We need to check these abnormalities further to find out where the discrepancies are, so we looked at the lowest level, the sub-centres of Paipalem. Figure 7-5 reveal that it is especially Kuppam West and Cheelapalle that causes the abnormalities. If we know in which sub-centres the abnormal data is collected, it is easy to find which field worker has collected the data and what might be the problem. Looking at the data in this way, anyone who uses the system are able to see where the discrepancies are and know where to take required action.

![Figure 7-5: Ante natal care check-up cases for Paipalem sub-centres.](image-url)
Figure 7-6: Ante natal care check-up (ANC) cases of all primary health centres except Paipalem.

Leaving out Paipalem (figure 7-6) the diagram turns out much more probable!

Figure 7-7: Ante natal coverage for all primary health centres.
Figure 7-7 illustrates the ante natal coverage for the primary health centres in Kuppam. The state of Andhra Pradesh struggle for a high coverage, as it affects the infant and maternal mortality. The high percentage for Paipalem is already described. Generally, the coverage in the area is low.
7.2.4 Maternal and infant mortality rate - institutional vs. home deliveries

One of the goals is to minimize number of home deliveries and correspondingly increase number of institutional deliveries. The high rates of maternal and infant mortality influence these performance indicators. If the indicators show that maternal mortality and infant mortality rates are low in the area, then institutional deliveries should have a high percentage, and vice versa. If institutional deliveries are low we should see a high maternal and infant mortality rate. However, this is not the case in Kuppam. Maternal and infant mortality rates for Kuppam give an impression of being low, but this is because of poor registration. We found that out of the 47 sub-centres, only 19 have registered anything. For rural areas in Andhra Pradesh, the infant mortality rate was 70 in 1997 (census 2001). Figure 7-8 illustrates that home deliveries are reported to be 64% of all deliveries, a percentage that indicates a higher maternal and infant mortality rate than what is reported. The reason for the high home delivery percentage might also be that some of the institutional deliveries (at private clinics) are not reported. Note here that only 70% of all live births are registered, as pointed out above.

Why are maternal and infant mortality deaths not reported? The reason is that the primary health centre and sub-centres are put in “a bad light” if they report high maternal and infant deaths. At monthly district meetings, medical doctors are under pressure to keep these rates down to put the district in the sunshine, so to speak.

![Pie chart showing home deliveries (64%) and institutional deliveries (36%)](image)

**Figure 7-8: Institutional deliveries vs. home deliveries**
7.2.5 Correlation in life cycle events

In this final section, we would like to illustrate variations across important life cycle events. The cycle uses four data-elements that all register infants less than one year. The elements and a short description of them are given below.

Antenatal cases registered (total): This is the total number of pregnant women registered in the area. It should be the highest number compared to the other data-elements described below.

Total number of deliveries: This is the total number of registered deliveries conducted, including live and still births.

Number of infants given BCG: This is the number of infants given the BCG vaccine. The vaccine is given just after births, and therefore it also serves as a proxy for the number of infants having access to the health facility. The number should then naturally be equal to ‘live births’.

Number of infants given Measles: Measles is given as the last and final vaccine (for the child to achieve full immunization status) in the 9th month. This serves as a proxy for health facility access after nine months.

The four following figures below present these data-elements. First a total and estimate of all the primary health centres in the pilot area. Then a down-scale of the total showing all the primary health centres separately are done. Finally, to drill it down to grass-root level, we present the data for some sub-centres. The estimates in figure 7-9 are calculated using census data, household and the targets given in table 7-2.

Figure 7-9: Variations in registered cases of life cycle events, total for all nine primary health centres. The estimates are calculated using the targets given in Table 7-1.
Figure 7-9 demonstrates that the difference between registered and estimated vary between 20 and 30 percent for all the four elements. There is only coverage of 70 to 80 percent compared to the estimated numbers. This discrepancy can be explained in different ways:

20 - 30% are not reached by the health service. There can be several reasons for this; the health workers may not be doing their job properly or their workload is too high. It can also be lack of resources available to do the required job, or that the community do not see the importance of receiving health services.

The population numbers are incorrect. As already mentioned, the census data is expected to be the most reliable source, it is the official numbers reported throughout India and is done independent of district and state officials. The population numbers reported by the health workers themselves (household register) are much lower than the census data. The main argument against using the household register is that it can be biased. The higher number the health worker reports, the more work she has to do because indicators and especially targets are set higher. Naturally household numbers match much better with the actual reported number because they come from the same source.

Finally, it might be a combination of the above or other reasons that we are not aware of. Another interesting point is the symmetrical linear drop from “Ante natal cases” to “Live births”, then the asymmetry from “Live Births” to “BCG” and finally a symmetric line in the drop from “BCG” to “Measles”. The symmetries are a sign of not given health services, and the asymmetric line from “live births” to BCG indicates the importance and awareness of the BCG vaccine. Another reason for the asymmetry between live births and BCG is over reporting of the two vaccines due to poor reporting procedures (e.g. one infant given two BCG injections, for some reason, are reported as two infants given the vaccine).
Figure 7-10: Variations in registered cases of life cycle events for all nine primary health centres, normalized related to population in area

The two figures demonstrate the ability to investigate data at grass-root level. Figure 7-10 shows the overall picture for the pilot area, but it is hard to use this data in order to achieve action for improvement. Figure 7-10, however, illustrates the ability to confront the primary health centres and then the sub-centres with the data they themselves have registered.

Figure 7-11: Variations in registered cases of life cycle events for some sub-centres for Ramakuppam primary health centre, normalized with population figures.
Figure 7.11 shows quite clearly that some of the sub-centres vary greatly in registered cases of life cycle events (ante-natal care, live births, BCG and measles). Now it is possible to confront and discuss with the field workers who register the data what can be done about the situation reflected through the graph.

7.3 Implications of data quality on issues of scale and sustainability

As this chapter illustrates, the quality of health data at grass root level is poor. On the issue of scale, the chapter demonstrates the usefulness of being able to track data down to those who actually register the data. A HIS that captures health data at only a higher level, for example at the district level, would be unable to pinpoint abnormalities (as described above), and poor quality data would be more difficult to detect. Capturing health data at grass root level enables a solid foundation for further scaling of the HIS.

Furthermore, a HIS that scales based on quality grass root health data would be more sustainable. A HIS that produces quality data would be more sustainable compared to its “competitors”.

7.4 Summary

The data analysis points at several important issues. Only 70% of the live births are registered, thus 30% of the pregnant women do not receive the health service they are entitled to. One reason might also be under-registration, but we know that women in Kuppam prefer to give birth at home, and the health workers might not be aware about the delivery.

Using indicators, we have found that vital data are not available in some cases (ref. maternal and infant mortality rate). There needs to be a greater emphasis on data capture rather than data reporting, i.e. the collection of high quality data. Further analysis and discussion will be given in the two next chapters.

Two field workers were confronted with the issue of data elements and targets. They had no problem understanding the elements in English. Targets, they felt, were set too high, and they almost found it humorous that the targets varied based on who set them. They gave an example of the target for sterilization; it is calculated to five per month, but the Medical Officer would raise it to ten, and then the Statistical Officer would raise it to 12. These targets were impossible to achieve on the ground.

Parts of this analysis made the basis for a draft that the HISP team presented to the Department of Family Welfare in Andhra Pradesh in December 2002.
8 Analysis and Discussion: Scaling and Sustainability of HIS

“While I appreciate what you are trying to do, the systems are of no use ‘till you give me information about all the 1200 primary health centres in the state, and how these link with the e-governance initiatives that we are initiating at the state level. Also, I want these systems to be implemented very quickly.”

C.B. Naidu, former chief minister of Andhra Pradesh

The quote is a remark HISP got after a presentation to Naidu in an initial stage of the project. It illustrates what a HIS has to accomplish to be institutionalized – a fast and large scaling of the HIS. The aim of this thesis is to improve understanding of the challenges and opportunities for scaling and sustainability of HIS in developing countries. For successful implementation of a HIS you need to have it institutionalized (Braa et al. 2004), and I will argue that to institutionalize you need a development process that successfully can deal with the scaling and sustainability processes of the HIS. Furthermore, it is vital to recognize that the two issues are interdependent. The challenge is how the development process deals with human resources, infrastructures, politics, culture, donors and geographical issues typically found in developing countries. The opportunities are that these processes can lead to institutionalization of the HIS and potentially contribute to improve public health care in developing countries.

The strategy used by HISP is based on a bottom-up, participatory, democratic, evolutionary and cultivation approach. The advance of such a strategy has both its advantages and weaknesses. To better understand this approach, this analysis will call attention to the challenges and opportunities HISP’s strategy has created with respect to scaling and sustainability. First, I will focus on how scaling and sustainability are affected by the processes of institutionalizing HISP from both micro and macro perspectives. Second, I will use concepts from information infrastructure theory to analyze and discuss the socio-technical challenges and opportunities for scaling and sustainability of HISP. Third, I will discuss possible strategies for addressing the identified challenges. Finally, the last section discusses how issues of scaling and sustainability are interdependent.
8.1 Scaling and sustainability of HISP in Andhra Pradesh

Both micro and macro perspectives have been used to study the issues of scaling and sustainability of HISP, which are presented in the following two sections respectively. The first sub-section analyzes the micro issues comprising of the heterogeneous network of technology, people and processes more at the grass-root levels. The second sub-section analyzes at the same socio-technical issues at the political and bureaucratic level from a macro perspective.

8.1.1 The challenges and opportunities with bottom-up

HISP’s plan for creating a better HIS, is to have local health workers take responsibility for the health data they themselves register by using and analyzing it (Braa and Hedberg 2000). If they do this, health workers can potentially take action and contribute to improve public health.

During the project’s times-span, proper training of the field workers were planned and conducted on a regular basis, as both beginner and follow-up courses. Based on the training, some field workers learned to use computers to register health data, make simple spreadsheets (e.g. to plan schedules), and gave feedback on data-elements in the application. The classroom training gave HISP the opportunity to meet field workers and doctors simultaneously. HISP could then inform and get valuable feedback on the project from the stakeholders involved. The classroom training in Kuppam also to a certain extent helped to reduce the number of computer hardware issues as it was also supported by a private NGO with skilled people. The one-to-one teaching sessions at the primary health centres helped to develop close relations between the trainers and the field workers. This provided valuable information that would have been difficult to obtain from interviews and questionnaires. Finally, the trainers who got involved took considerable pride in being part of the project. Some of them have stayed on over several years, gaining more responsibilities within the HISP structure.

However, it was found that only a limited number of field workers expressed a deep interest for learning during the training-sessions, and many showed indifference to the project and its goals. To get to the classrooms, many field workers had to travel a long way, thus the turn-out was often low. Many did not receive the attendance schedule on time from their medical officers. This was partly due to the difficulty in communicating with the doctor at the primary health centre (e.g. the telephones were often disconnected); partly due to the neglect of doctors; and partly due to time constraints (the field workers had too much to do). Also, although HISP primarily focused on field workers, they also tried to include doctors. Because of this, much of the hierarchical structure of
the health system was recreated. For the field workers, the training-sessions did not represent anything different than their everyday work.

The efforts towards direct training at the primary health centres provided different challenges to the HISP staff. The hardware problems made it difficult to enter data and conduct training on a permanent basis. Because data-entering was more decentralized, the doctors became more central in the project. They were directly responsible for the computer at the primary health centre and for entering the health data through the field staff. Consequently, those who disliked the project had more influence to oppose the guidelines given for implementation. For example, some doctors gave explicit instructions to all field workers that they personally were responsible for the computer. The result was a halt in the registration for several months as no-one used the computers. Finally, much of the health data was entered directly into the application by the HISP trainers. This was done because HISP needed to populate the database fast, but it was also a sign of disinterest in the project among the field workers.

Another problem that slowed down the training process and the project in general was the ongoing problem of local adoption of the DHIS application. Again, because of the pressure to populate the database fast, local adoption, training and health data entering was done simultaneously. Since the local adoption was continuous and ongoing through an inexperienced team, the application was altered several times. Thus, the health data was often lost and had to be re-entered a few times. The working conditions in Kuppam contributed to a slow implementation. For example, just collecting the entered health data at the five-six primary health centres took three to four days. Then the modification had to be done (usually in Bangalore due to unsatisfactory equipment in Kuppam), often taking several days. Finally, to install the database at the primary health centres, another three or four days was used.

The poor infrastructure in Kuppam is part of the problem for the slow progress. One of HISP’s goals is to contribute to the improvement of the infrastructure in rural areas, but instead HISP often ends up being the victim. The cluster approach was a strategy used to partly deal with this issue. Instead of pushing for upgrading the primary health centres, HISP chose to accept reality and use the feasible structures available. This gave important knowledge on problems one might experience at a later stage, e.g. field workers at primary health centres with no computer made slower progress. Nevertheless, the cluster strategy did in no way solve the infrastructural problems. In the primary health centres where the computers were installed, the computers broke down regularly. In some cases we found rats to have eaten the printer cables. Internet was also impossible to install because of lack of networks.
The academic approach that HISP is using has been both helpful and difficult when examined from a micro perspective. It has been good because it attracts human resources to the village where the primary health centres are. In Kuppam, programmers from IIMB and other students worked on the project for several months. This was successful because local people involved in the project could see that people were dedicated to working in the area. Furthermore, the fact that the project was rooted as a global, university based project, many of the people in the project saw opportunities beyond Kuppam, and even India. What is problematic about the academic approach, as analysed in chapter 4.2, is that several of the students stayed with the project for a relatively short time span. This resulted in the loss of important continuity and know-how in the project. Also, students are there mainly to do research and down-prioritize the “hard labour” that often needs to be done to implement the project. The action research strategy helps a lot in this respect, but is still different and less effective from how a professional with a full time commitment would have worked.

In summary, the hardware problems, limited resources, a rather inexperienced team, continuous adoption of DHIS to the local needs, and at the same time to do training and entering health-data, all contributed to make the implementation a time-consuming and complex process. It is easy to understand the resistance among the stakeholders, for example for the health staff who saw their task increasing with double registering of the data (both in DHIS and on paper) over a long period. For the pessimist, HISP was just creating extra work as part of a research project. On the issues of scaling and sustainability, it is easy to see the challenges. All the problems encountered at the primary health centres make it difficult to have a sustainable project, because users start to dislike the system. For the same reason, not having the local users on your team, makes scaling difficult. For a HIS to scale and stay sustainable it is has to be owned by the users, as more people want to try out the system, and they should also have the capacity to make it grow. This is why the method is used in the first place, but as we see it is difficult to make it work.

8.1.2 The challenges and opportunities with the top-down

Several HIS pilot-projects have died in developing countries because of political and bureaucratic decisions (Braa et al. 2004). One challenge for HISP in Andhra Pradesh was to influence politicians and bureaucrats on the boundaries of the project, in terms of gaining more resources and geographical coverage. As a start, HISP was given a small and remote rural area to pilot. For the decision makers, the start-up of the project was relatively low cost, could potentially boost local political popularity, and might give the village a few extra resources e.g. through governmental programs and donors. However, as the project continued over time and more money was needed, both to continue in the village, and to diffuse, support was more difficult to gain. It was difficult to argue for continued support in the village because the top decision-makers
could not see the value of the project, as the health data collected was only from a few primary health centres and consequently had no real value at the state level. To collect health data over a larger area, or at a higher level, was just as difficult because this would increase expenses and human resources. In addition, the Family and Welfare Department commissioner was more supportive of the competing FHIMS project, and a DM&HO who supported HISP resigned, which further impede the scaling problem.

Bold and long term HIS projects are often initiated by politicians. However, many projects are often too bold and ambitious and the results are rather subject to high costs, slow progress and corruption. Thus, these HIS projects most often fade away and die. The FHIMS case has shown that although political support is given from the top with computers in every primary health centre in the state, the HIS is still far from being fully institutionalized.

As mentioned in the previous section, one of HISP’s goals is to improve the infrastructure at the primary health centres. An improvement in infrastructure over a large geographical area poses challenges to scaling because new and different problems arise as the system tries to scale. For example, the problem of human resources in Kuppam was partly overcome by tying up with a local internet café in the town that could support some hardware needs. HISP also hired a hardware technician that could fix some of the hardware problems. However, in other areas, internet cafés might not be around, and it might be difficult to find a hardware technician that is willing to move to rural areas. So, new solutions to the same problems would have to be tinkered on as the system scales. If the infrastructure generally was better across the constituency or state, these problems would have been easier to overcome. The problems can however to an extent be avoided by lifting the data registration from primary health centre level to the district level, where infrastructure is generally considered to be better (see strategies in next section). It is also important to note that HISP is a relatively small project. With a small budget, compared to large donors like World Bank and IMF, it is difficult for HISP to push through large organizational changes.

Corruption can affect scaling processes because large scale implementation usually means that more money is involved, and consequently leads to more bribing. An example is how FHIMS, created by a large and financially strong Indian corporation, got a state-wide implementation without first having any significant results to present.

HISP had to constantly and simultaneously handle politics and bureaucracy in Hyderabad and Kuppam, struggle with the poor infrastructure and lack of human resources in Kuppam, battle for support from donors and other NGOs, and tackle corruption. Interconnected, issues of politics and bureaucracy, do-
nors, infrastructure, geography, and corruption, all magnify the difficulties for scaling a HIS. Separately these issues create their own problems for scaling, and taken together they make scaling exponentially more complex. Politics and bureaucracy influence how and where HIS prototypes are to be initiated based on the availability of infrastructure and human resources in the area. Donors also influence how and where a project is to be initiated, often conflicting with the will of the politicians and bureaucrats. Corruption, an underlying and cultural iniquity in many third world countries, is often an overlaying influencing factor. Because HIS are equally dependant on all these issues, complexity consequently increases with efforts to scale.

At the time of implementation, DHIS was not demonstrated as a complete and functioning system that could handle the accumulated data and the statistical analysis for the whole state. On one hand, this is negative because from the politicians’ viewpoint the project is not viewed as a complete system. On the other hand, it made HISP work with donors and other institutions to integrate the various systems. This was useful because it linked HISP with several other networks. Not only did it expand the network, it also showed politicians and bureaucrats the flexibility of the project.

HISP did eventually manage to get support for health data collection at each of the 13 district offices. Computers were set up and HISP team members started populating the database with monthly health and survey data. However, this was after the project had continued for several years and through political pressure from HISP’s high-level supporters. The health data collected was not used or reported further up in the health hierarchy, and the project remained un-institutionalized. Furthermore, when the Naidu government lost the election in 2004, HISP lost many of their political supporters in the government. New connections had to be made and HISP made several strides to get support from key political leaders in the new government, such as the new Principal Secretary of health. He was supportive of HISP, but by beginning of 2005 too much money had been invested in FHIMS, and made it a decision which was hard to reverse.

In summary, the challenges and opportunities with macro issues are mainly how politicians and bureaucrats are nurtured to support the HIS. The above describes how dependant HISP has been on the support from politicians and bureaucrats and demonstrates the rigid and hierarchical structures that exist in India. Without proper support from politicians and bureaucrats from all levels in the health hierarchy, it is difficult to achieve scaling and sustainability of the HIS. The rigid power structures in India make it particularly important to have support at the very top of the hierarchy, which probably can influence all levels below for better support of the HIS.
8.1.3 How the bottom-up and top-down are interconnected?

The two sections above have analyzed from micro and macro perspectives the challenges and opportunities for HISP on issues relating to scaling and sustainability. In this section I will examine the mutual influences of the two perspectives.

A top-down approach has implications for resources at the grass-root level. With the HISP project, it is quintessentially the politicians that control the money available for the various projects in Andhra Pradesh, and how the money is used. This has implications for labour supply, improvement of infrastructure and donor related issues. Better economic support from the politicians can lead to more and better labour supply at the primary health centres, for example for better and more training of the health workers and managers. Improving the infrastructure will reduce the many problems experienced at local level. For example, working telephones and more available computers can make it easier to implement the project. Politicians also control how projects are distributed in the various districts in Andhra Pradesh. HISP with its limited economic resources available is dependant on political backing. With more projects competing for resources, fewer resources are in practice available for HISP.

Likewise, a bottom-up approach has implications on political decisions. How well the project performs at local level affect further political support. For example, if HISP had been able to generate results that politicians and bureaucrats would find particularly useful, more resources and support might potentially have been put into the project.

![figure]

Figure 8-1: Mutual influence of the bottom-up and top-down.

Looking at figure 8-1, the mutual influence is basically that more support from politicians usually results in more resources for the project. Better available resources usually generate better performance at the local level, which again gen-
erates more support from politicians. Thus, both political support at the top and good performance at the bottom are equally important.

### 8.2 An Information Infrastructure (II) informed analysis

In South Africa the process of creating standards, which plays a major part of an information infrastructure, have helped the system to scale and stay sustainable. The overall goal of this section is to analyze scaling and sustainability of a HIS based on the concepts of a HII, as described in chapter 2. The strength of a HII perspective is that its concepts are better suited for analyzing large and complex information systems like the HISP project.

“An infrastructure is an evolving shared, open, and heterogeneous installed base” (Hanseth 2000, p 60). The problem of scaling HISP can be analysed as how to change the installed base. If we see the existing ‘paper-based’ HII (health information infrastructure) as the installed base and HISP as a competing HII, the problem of scale can be analysed using II concepts. Specifically, the challenge of introducing this new but incompatible technology that can potentially overcome the switching cost from the paper-based network. However, the paper-based network has through the ‘standard reinforcing mechanism’ (see page 21) (or increasing returns) evolved into a lock-in state, which makes it difficult for counter-networks to compete, due to the huge costs involved. Nonetheless, gateways are proposed as a way of dealing with the locked-in installed base (see e.g. Braa et al. (2007); Hanseth (2000)).

HISP used gateways to deal with the locked-in networks in Andhra Pradesh. One gateway was between the existing paper-based system and DHIS. This was done using the same data-elements and creating reports identical to the forms used on paper. DHIS could then be used in coexistence with the paper-based system for reporting to the district and state. Another gateway used was by developing the integration tool between DHIS and FHIMS. This enabled HISP to work closely with a project that had more political support and more resources available.

Standards are the raison d’être of an II. To analyze how standards effect scaling and sustainability of a HIS, we must analyze how these standards are resistant or flexible to change in the socio-technical network. As Hanseth (2000) points out, standards evolve through the standard reinforcing mechanism that creates a larger installed base. II theory suggests that scaling of standards is related to changing flexibility, and that this is enabled by modularization. In this thesis, this can be analyzed as: 1) how HISP has used cultivation as a strategy to create the standard reinforcing mechanism for its network; 2) how the existing paper-based network has been resistant to change; and finally, 3) how the use of gateways has helped the HII to be more simple and flexible. The three concepts
of II above are all related to how scaling and sustainability processes are affected. These are now discussed.

8.2.1 Cultivation

Cultivation is the process where a health information system starts in a specific location with some basic principles, but is then left to drift on its own based on local commitment and ownership. To create such local commitment and ownership, the cultivation approach used by HISP in Andhra Pradesh can be seen to be evolutionary, bottom-up and involving a participatory design process. It is thus useful to analyze how this approach influences the scaling and sustainability of the project.

From the start, HISP spent a large amount of time in the area around Kuppam with the HISP project. On one hand, getting the pilot to function well for six-seven nodes proved difficult for several reasons: First, the infrastructural problems resulted in both collecting the large amount of data needed, and also to train the field workers appropriately. The infrastructural problems concerned limited amount of electricity, human resource related problems like lack of technicians to fix the computers. Second, it was difficult to convince politicians and decision-makers to allow the systems to be used in other places because of the relatively slow process of collecting data, and because HISP was a rather small project with little money to offer.

On the other hand, the cultivation process created opportunities as well. After some (1-3 years) time, HISP managed to overcome some of the problems. As hired local staff and some of the field workers got more involved in the project, some of the human resource problems were solved (e.g. by deals with local businessmen). The electricity problems were better dealt with by getting an overview of the power-schedules at the primary health centres, so less time was wasted when travelling to the locations. Furthermore, HISP’s request to work together with the FHIMS project finally resulted in a go-ahead to integrate the two. This was made possible because of continues request from HISP and because of some politicians’ discontent with the FHIMS project.

A larger issue, however, is how to spread/replicate the process of cultivation to other new places. Hanseth (2002) points out that a successful implementation of infrastructures requires a creation of the self-reinforcing mechanism, and then a management for its direction. Gateways are important tools in such a providing (see Braa et al. 2007), which is discussed in the next sub-section.

8.2.2 A locked-in system

The existing working system in Andhra Pradesh is paper based. This basically follows the principle idea of reporting on paper to a superior, who aggregates the data, and again reports the data to the next level in the hierarchy. In India,
the existing system of reporting health data with pen and paper has been historically embedded, and staff find it simple to register with pen and paper. In the old days, this was the only option. In order to analyze why it has been difficult for a computer-based system to enter the arena, is to look at how IIs evolve through the standard reinforcing mechanisms. For the case in Andhra Pradesh, the installed base of the paper-based system has been worked on and improved over decades, and thus many of the complementary products that surround it are tailored for this existing system. Especially in India where hierarchies and formal structures are a way of life, it has been difficult to “break in” with a new system.

Another important factor why it has been difficult to compete with the paper-based system, is that when introducing a computer-based system in such rural area, it often shows that the technology is made for Western standards. The existing paper-based system has the advantage that it simple and to a certain degree works in a rural area without electricity, and requires less expertise etc. This way of reporting data works to a certain degree fairly well in rural India.

Subsequently, it makes sense to claim that the paper-based system is in a lock-in state, and thus it is very hard to change it. Regarding scaling and sustainability, we can analyze the implications/difficulties for a new system being introduced when the other is in a lock-in state. Again, gateways can be used to deal with the processes of transition.

### 8.2.3 Using gateways

HISP has used gateways to create sustainability and scalability. The cooperation with FHIMS (integration tool), the system of typing paper-based data directly into the database, and by trying to work together with several other development projects in and around the area has to a limited degree made HISP more sustainable. The gateways that have been applied, have been used to transfer data from the cooperating partner to the DHIS application, so that it can process the health data, and give the required data, e.g. reports. The reason for this is that the DHIS application is relatively easy and can import data from other databases because of its relatively easy way of dealing with the health data (i.e. aggregated data only). More theoretically, the use of gateways has in this way helped created a standard that is simple and flexible, and that with some work, basically everyone can connect to (i.e. it is a shared, open and heterogeneous installed base).

Nevertheless, although there is a possibility that everyone can connect to HISP’s network, very few have done so. In the big picture, HISP’s installed base in Andhra Pradesh was relatively small. This was because HISP was not able to produce enough complementary products to its installed base, and thus
the existing remained unchallenged. Thus HISP remained basically as a separate network.

Being part of a “small” network is problematic, and adds to the complexity of creating sustainable and scalable HIS. For a HIS, the same business logic has to be used over a larger geographic area based on the “all or nothing” principle (Braa et al. 2004). All health data has to be collected over the same large area to calculate and use (e.g. indicators) the health data for something practical, e.g. to analyze the data, and based on it make changes in the areas that clearly need more attention. In Andhra Pradesh, only one of the several vertical programs used HISP to collect and analyze health data. This was problematic as it limited the analysis of data across the vertical programs.

8.2.4 Scaling and sustainability of Information Infrastructures

Successful implantation of an II requires the creation of the self-reinforcing mechanism, and then a management of its direction (Hanseth 2000). Strategies for creating and managing such processes are here called cultivation. This is related to network externalities, meaning that it is better to be part of a big network than a small one, all other things being equal. The challenge is then how to deal with the existing installed base in a way that leads to a faster implementation of the HIS.

The Scandinavian approach, evolutionary development and cultivation are processes that are used because domain understanding of the problems is low and we do not now exactly what kind of approach works best. A problem with the cultivation of the II in Andhra Pradesh has been that the steps have been too small, so that a critical mass and the needed momentum has not been achieved. Extension of the HIS to the entire Chittoor district is the first goal, and to the entire state has been the ultimate goal. In order to achieve such scaling, however, support from higher levels would be needed; first by the district level (so that they would support expansion to new areas of the district, and to the entire district), and second by the state (so that they would support expansion to new districts and ultimately the state). This is a classic “what comes first” situation; one needs to support the districts in order to get their support and interest, which would be to make information from the whole district available. But in order to cover the whole district, support from the district would be needed from the outset. This is the dilemma that is called “all or nothing” (Braa et al. 2004). The process has taken too long time to spread out sufficiently, i.e. to reach a critical mass, for the system to be institutionalized.
8.3 Possible strategies for scaling and sustainability of HIS

This section discusses possible strategies for scaling and sustainability of HIS, and its consequent institutionalization. Factors that influence the strategy are how to deal with socio-technical heterogeneous processes. This includes bottom-up and political processes, dealing with rural and infrastructure problems, donors, how and where to collect health data and the use of technical advances.

8.3.1 Bottom-up versus top-down

As we have seen, the micro and macro perspective viewed two ways of implementing a HIS from the start. One was a bottom-up viewpoint and the other was top-down. The preferred choice of strategy should be the most efficient to get the HIS institutionalized. The two have tradeoffs and are interdependent and thus have to be carefully considered and combined.

The bottom-up decentralized choice is based on the political ideology of empowerment. This strategy is to start small and decentralized to get an overview of the challenges and opportunities for collecting and using the health data, and then do well enough to convince decision-makers to give further support to the project. A decentralized HIS may be preferred because it is at the grass-root level the problems are, and thus changes have to be made where the problems really are. Furthermore, one can use the HIS to make such changes. Results in this thesis suggest that you get new and valuable knowledge of the problems when doing action research in a remote village. Such knowledge is important because it can improve the HIS (through processes of evolutionary development), which makes it also easier to subsequently diffuse the IS.

There are, however, several problems with a bottom-up strategy. One is that if the project does not do well in the start, further support will probably not be given. It can be argued that poor functioning pilot projects should not receive any more support. Rightly so, but a HIS is a system that develops over a long time, and to determine if it works well or not after a few years is difficult. When should the decision-makers decide when to give up a system, stop wasting money, and give the chance to another promising project? Two, three, five years? There is of course no general rule here, so the decision-makers can only rely on the information they have at hand to allow a project to continue or not.

Furthermore, problems vary from one geographical area to another, so there can be no quick and simple replication. Improving on the problems in one village might be possible, but to improve over the whole state, or country, is a problem of another dimension. To do that on a global level, politicians would need to agree upon a plan that lasts for several years, if not decades.
Getting support from politicians is an imperative for starting a HIS pilot. At what level you get support is important. Generally, the higher level of support the better, as the rigid and formal hierarchical structures are often very strong to subvert. However, having local and mid-level bureaucrats and politicians on “your side” is just as important. They can contribute a lot to the successes of the pilot by giving good feedback to higher levels, by working for instead of against the project. Nonetheless, it is the top-level politicians that eventually decide an eventual expansion of the project and potentially deciding to institutionalize it in some way. Alongside getting support from politicians, it is also important to get the system institutionalized as fast as possible because politicians and bureaucrats come and go, usually over a 2-3 and sometimes up to five years. Having support for five years should be sufficient, but as in this case this was not long enough to get it institutionalized and survive a democratically elected new government.

Only through political willpower and proper long-term planning can infrastructures be improved within a country or state. It is possible to fix problems locally, as described in the previous section, but this is besides the point and outside the definition of an infrastructure. The infrastructure has to be improved over a large geographical area and in every node to be of potential use. Improving a few primary health centres in a district for example, would not give much change in overall improvement.

The two strategies described above are interconnected. In practise, the question is not to go with one or the other, but where you focus your resources. Success has to be at both top and bottom. To believe that the system can grow bottom-up in a Marxist way, through the empowerment of field workers is very difficult in hierarchically embedded systems. Reverse, implementing a system based on pure political willingness has also proved to be a failure is most cases. A dictator-style implementation could work if you have the right system, but in reality you do not. Consequently you have to find a golden middle way. The HIS studied in this thesis had a very strong focus on working at the grass-root level. A fundamental problem with this strategy is that the challenges are so great and are difficult to address only through local mechanisms.

### 8.3.2 Creating clusters

To overcome many of the problems described above, a cluster strategy was adopted. An illustration of the “cluster-plan” is shown in figure 8-2. Each of the surrounding primary health centres (PHC) and the primary health centres' corresponding sub-centres (SC) report directly a designated primary health centre that have a computer. Since most of this work is put on the field workers at the sub-centre, it is each and all of these field workers that have to come to the computer to register their monthly health data.
A key point is to identify a good primary health centre within a designated area that has a fairly good infrastructure. This implies stable electricity, staff and medical officer have to be supportive of the system, and roads and bus connections to the place must be good, especially from the surrounding health centres. This arrangement gives the HIS a lot of diversity. The creation of such “super-nodes” is imminent, as it reduces the cost and resources needed in the project. It also has the advantage that some people will be more actively involved in the project. The strategy is a quite flexible and an adaptable method of spreading the project, but as experiences have shown that a cluster strategy also has disadvantages that must be considered.

Experience has shown that the primary health centres that do not have a computer have a slower progress than those who have one. Entering health data is tedious work and time-consuming for the field workers. Thus, in PHCs that have a computer, the field workers are given better support and they show a better learning curve than the ones “left out”. This again affects how people in the project relate to the users, in terms of training, follow-up etc. Thus, a skewed institution within the project is created that further marginalizes those PHCs without the required infrastructure.

The use of the cluster strategy showed that it is possible to improve on some of the problems at the grass-root level. There is a trade-off between how you choose a cluster. A too large cluster with many connecting primary health centres, can result in too much distance for the field workers to travel. A too small cluster with few connecting PHCs can sacrifice the quality of the reporting station.
8.3.3 HISP as a parasite

HISP works in collaboration with many other projects initiated in Andhra Pradesh. By having close relation to other projects that has money, political and bureaucratic support has enabled HISP to sustain and further grow as a project within Andhra Pradesh.

One good example to describe this is the collaboration with CMC. The FHIMS has to some extent been a failure in terms of capturing health data. As a result of this, the memory of understanding/agreement signed between the Department of Family Welfare and HISP, stated that FHIMS and HISP should collaborate on creating a tool that can populate the captured data in FHIMS and then import it into DHIS (see section 6.5). At a later stage, HISP has leveraged on further on CMC’s failure to deliver on other government projects (see e.g. The Hindu (2002), where the chief minister state that CMC should be “blacklisted” from government projects because of poor performing IT systems during the Asian games).

As was the case in South Africa (Braa and Hedberg 2000), HISP has gained on the failure of other HMIS. The persistent belief among key decision-makers that it is possible for Andhra Pradesh to “leap-frog” directly from a poorly functioning paper-based HIS to a highly sophisticated and fully integrated state-wide network solution based HMIS has enabled CMC to pursue the development of FHIMS. A majority of similar complex health care information systems have been a failure in developed countries (Heeks et al. 1999, and pursuing them have drawn considerable resources and attention away from simpler, district-based solutions. It has been harder to institutionalize HISP because of the CMC-project since it has drawn most attention and resources from the Family Welfare Department. However, it is because of the failure of the complex FHIMS, and HISP’s dedication to stay in Andhra Pradesh that has allowed HISP to continue in the state thus far. The relatively low-cost budget makes it easier for decision-makers to give further support.

The academic approach makes it easier to stay for a long time in the same area, as it attracts more educated people with connections. Furthermore, no ulterior motives beyond improving health are present. All of these increases the potential for scaling and to stay sustainable.

8.3.4 Strategies for collecting health data

One important aspect of the bottom-up top-down viewpoint is choosing what level to collect health data and to populate the HIS. There are many granularities of collecting health data, but it basically follows the administrative hierarchical structure, i.e. from individual to collecting at SC or PHC or district levels. Figure 8-3 gives a schematic overview of three different ways of col-
lect data. The figure follows the level where one can track the individual, not at the organizational level (i.e. not where data is stored but at what level information is available).

Figure 8-3: Three different ways of collecting data up to district level

Looking at the figure vertically, the illustration has three different approaches that maps to the three strategies described in the previous section. The leftmost line represents a low cost and detail of computerization. The advantage with this view is that data is computerized for the PHC, and entered and populated at the district. The middle line refers to the cluster strategy described. Here, the field workers collect data on an individual level in their diaries. This data is then aggregated on paper forms at sub-centre level and then fed into a database at a PHC. This means that computerized information is available for all sub-
centres. The “parasite strategy” described above refers to the rightmost flow, where the detail of data computerized is high. Thus, the cost is also high.

By looking horizontally along the PHC line, one sees that health data is computerized at this organizational unit. The state of Andhra Pradesh will have an overview of the 23 districts and that the state and district will have computerized access to the data from the PHCs. Not only will the state be able to monitor health related issues, but will have the capabilities to link some of the data collected to various e-governance initiatives. For example, a Graphical Information System (GIS) can be used to see primary health centre profiles. Basically there is a trade off between low and high level of computerization of health data.

Generally, at the state level, the main aim is to have an overview and access to health data throughout the state and not just fractions of it to make decisions. The political situation is also demanding for something visible to the public and health data from nine PHCs or in the best case from Chittoor district, it has been difficult for HISP to prove its capabilities in Chittoor to the Ministers at state level because support has been modest from both the state and district.

Nevertheless, if one manages to populate the HIS at the districts, one would have information easily available for analysis from the PHCs and up to the state. This would imply an introduction of stable and reliable database for health care data in the district. Hence, a shift from a highly worked-in paper based system to a computerized system within Andhra Pradesh’s state level HIS is foreseeable.

8.3.5 Technical insurgents

One strategy to convince politicians and bureaucrats to give support to a project is to use new technology. The HIS analyzed in this thesis has a foundation in being simplistic in the way it collects and uses the health data. The argument is that a simple model using simple technology is much more flexible and robust for tackling the many complex challenges in a developing country. Instead of focusing on solving every problem with new technological artefacts, the project focuses more on training and blending in with existing infrastructure. However, to get political support, new and exciting technologies often need to be incorporated in the project.

As described in this thesis, the use of GIS and the internet was used in such a manner. Especially GIS has a very promising use for HIS. Using this technology, statistical data can be displayed in maps for further analysis. To do this in practice, three basic components are necessary. First, an essential part is the digitalized maps. In a developing country such digital maps may not exist. If they do, they are of poor quality, or they can be difficult to get hold of. Sec-
ond, for proper analysis you need a lot of and complete health data for a large geographical area. Since the whole idea of a HIS pilot is to find a more effective way of collecting and computerizing health data the whole situation becomes one of a catch-22. Finally, you need someone who has the know-how of working with the GIS. GIS software is expensive (although some vendors give discounted software for charitable organizations) and not off-the-shelf software. Consequently you have to hire professionals to do the job or start educating people in the project team. If any of these three components are unavailable, or of poor quality, it is very hard to do something useful with the GIS technology. If you do have them, you can create flamboyant and convincing statistical presentations to politicians and bureaucrats (and for real use also).

Although potentially of great value, to use Internet at a grass-root level, it is at the moment not possible because of the infrastructure problems described. In most rural areas the Internet is simply not available or reliable enough. However, it can be used as a portal for information about the project, and potentially as an interface for connecting other governmental projects to the HIS. The problem is that this is not a core part of the project, and usually few resources are used for creating web-sites. In addition, overall guidelines for creating local websites are not given, and the results are usually rather poor static sites.

8.4 How scaling and sustainability are interdependent

The main reason for HISP's failing to stay in Andhra Pradesh is that it did not manage to get institutionalized due to two main reasons. One, the political support was mediocre, and two, the implementation process took too long time. Both reasons can be related to scaling and sustainability. Politicians and the implementation process did not allow the HIS in scaling fast enough. The cultivation process that started with a new heterogeneous network in India took considerable time to establish, and the majority of politicians and bureaucrats could not see the value of the HIS. Furthermore, politicians made the project unsustainable by poor support, and the implementation process made the project unsustainable by not producing desired results.

As we can see, these reasons are mutual dependent on each other. The politicians gave poor support because the implementation process was slow, and the implementation process was slow because political support was poor, hence the catch-22 situation. Subsequently, the HIS is not allowed to scale unless it is sustainable and it does not become sustainable because it is not on a certain scale. The interdependency of scaling and sustainability is illustrated in figure 8-4.
I have argued that when implementing a new HIS in developing countries, scaling and sustainability has to seen as interdependent issues. It is not a matter of how to scale the information system, or how to only create sustainable development. It is up to both politicians and the project leaders to recognize this matter.
9 Final Reflections

To achieve institutionalization for a HIS it is important to recognize the inden-
dependency between scaling and sustainability. Both are important factors for a
successful implementation of a HIS, but they are rarely considered together. In
India, much of the focus has been on scaling from bottom-up, relying on culti-
vation to spread the implementation. While this has its advantages and neces-
ties, the lesser focus on top-down implementation affects the sustainability of
the HIS. Thus, the strategy chosen has effects on both scaling and sustainabil-
ity. In broad terms, the bottom-up evolutionary prototyping approach does not
by itself seem suited for the Indian context and need refinements.

One way of institutionalizing the HIS faster is to start registering health data at
a higher level in the health hierarchy. By moving the computers from the pri-
mary health centre to the district one gains several advantages. Because the in-
frasstructure around the district reporting units are generally considered better,
many of the problems of infrastructure can be avoided. More stable electricity,
reduced hardware error problems and better availability of human resources
would make it easier for HISP to register data on a monthly basis. The trade-
off is that one loses out on HISPs goal of local empowerment, and potentially
poorer health data quality. In a country like India, with its rigid and formal
structures and things takes time to be done, it is better to get institutionalized
as fast as possible. As the systems gets foothold at the district, registration at the
primary health centre could be initiated.

Furthermore, it is vital to have strong political support. Improving on this is
difficult however. HISP could work on how it presents itself, e.g. by improving
the various web-sites that exist. Making a strategic plan on what to present
when introduced in a new country could perhaps convince more politicians
and bureaucrats to support HISP. Nonetheless, the most important issue is to
convince as many politicians as possible to support the system. Again, this is in
my view easier if health data to present are available from a few districts com-
pared to some primary health centres.

One strong aspect of the HISP project is the willingness to make a difference in
the country. Although the project did not succeed in Andhra Pradesh, it has
now started up in four-five other states in India. The project has done better
because of lessons learned from Andhra Pradesh. In Andhra Pradesh, a new
network of people and technology was made during the five years HISP stayed
in the state. Moving the network within India has been easier than moving it from South Africa to Andhra Pradesh.

9.1 Further development

The new DHIS 2.0 currently in development looks promising. This uses technology that makes it easier to do cross-country development and has distanced itself somewhat from South Africa. Although there is still a need to build a heterogeneous social network at a new location, the new and exiting technology might be able to attract more human resources to the project.

Another new exiting development during the last years has been the advance in mobile technology. Although many promising mobile projects in third world countries have failed over the years, (e.g. the Simputer) they have better opportunities than the expensive, bulky and energy-hungry personal computer. Mobile phones are cheaper, simpler and more reliable, and market forces – in particular, the combination of pre-paid billing plans and microcredit schemes – are already putting them into the hands of even the world’s poorest people. Especially the One Laptop per Child (OLPC) project, a $100 laptop for the poor currently being developed, looks promising for collecting and simple analysis of health data in rural India.

Improvement in mobile technology and the new version of DHIS can affect scaling and sustainability of a HIS. This is because they can potentially reduce the many problems experience with human resources, infrastructure, politics, geography, culture and donors. Reducing these problems creates opportunities for scaling and sustainability of HIS, and thus the possibility to improve public health.


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