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Social Construction of Legacy Systems

A case study from a health information systems development project in Mozambique

Candidatus Scientiarum Thesis

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Abstract

This thesis is about challenges in Information Systems (IS) development in developing countries contexts, with an emphasis on challenges faced in processes dealing with improvement and replacement of Health Information Systems (HIS). Empirical data are collected from action research interventions in the Mozambican health sector. The work was done under the umbrella of a global action research project, called the Health Information System Programme (HISP). HISP has for many years been a major actor in the Mozambican health sector trying to initiate change processes and reform current HISs. HISP aims at facilitating better health care management through development of sound HISs including cultivation of appropriate social practices in the HIS domain.

By following development and implementation processes over an extended period of time I got the opportunity to better investigate how the Mozambican health care organization relates and reacts to change efforts. The research was informed by qualitative research methods, which typically can provide rich insight, important in relatively complex settings consisting of numerous actors and processes.

Theoretically I build upon a conceptualization of ISs being social systems. Social informatics acknowledges the interaction between technical and social structures; as how technology influences the social, and how the social influences the technical is seen as important for better comprehension of challenges connected to IS development and implementation.

I argue that typical priorities among stakeholders in centralized developing countries settings, as focus on immediate needs rather than long term solutions, control, and reluctance in support for significant changes, may lead to the unintended consequences of creation and maintenance of legacy systems. Lack of communication and consideration of real users needs among decision makers is a contributor to this, meaning that centralized contexts may be especially challenged in HIS projects, as the distance between decision makers and real users typically is substantial organizationally-wise. The research suggests that the dilemma of introducing small changes with a new IS and at the same time supporting further organizational development may be solved by implementing flexibility in the IS done practically through flexibility in design and by enabling implementation of emerging needs by looking upon systems development as a continuous process through the life time of the IS. By applying different change strategies for different levels of the installed base, getting away from legacy systems problems may be reached in change resisting social systems.

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Ficam Bem!

Kristoffer Fossum

1 INTRODUCTION

This thesis is about to better understand challenges to address legacy systems in a developing country's setting. The empirical study is drawn from field work and action research interventions in the Mozambican health sector. During 2004-2006 I carried out fieldwork for a total of 8 months during three separate trips. The practical objective for fieldwork and research was to study, improve and replace existing poorly functioning Health Information Systems (HIS). My work was done within the framework of a global action research project called the Health Information System Programme (HISP). HISP has for many years been a major actor in the Mozambican health sector trying to initiate change processes and reform current HISs. The general intention of HISP is to do research about *how* to improve, and *to* improve, HISs in developing countries settings by developing ICT solutions and appropriate social infrastructures *for* developing countries settings *in* developing countries settings that *work* in developing countries settings.

I will now present the research motivation for, and research domain of, the study. This will lead to the presentation of the research objectives, followed by an overview of theoretical concepts drawn upon, and then a short summary of the empirical foundation of the study.

Research motivation and problem domain

By acknowledging the coincidence related to where in the world we are born has given me the ideological stance that we should ideally possess the same rights and opportunities. However, most people would agree that in reality the situation is very different. Characteristically, developing countries are facing severe challenges in providing basic needs for the population, such as appropriate health care. The HISP project gave me the chance to do a contribution in this field.

It is recognized that to enable sound decision making the importance of appropriate information cannot be underestimated (Rodrigues, 2000; Lippeveld and Sauerborn, 2000). ISs may function as instruments for provision of this information, and are seen as crucial support mechanisms for organizational operation (Lippeveld and Sauerborn, 2000). Introduction of appropriate ISs is believed to have the potential of by far enhancing the informative capacity for its target environment and improving the performance of the organization (Neumann et al., 1996; Raghupathi, 1997). In the health domain there is no difference, as health systems rely on appropriate HISs to obtain timely and reliable information to support decision making around sound health service delivery (RHINO, 2001).

Appropriate health is acknowledged as fundamental for life quality of individuals and development of society in general (WHO, 1978; Zipperer, 2001). Recognizing this, improving and having well-functioning health care services in developing countries is considered as very important for general development (WHO, 1978). However, developing countries typically face strong challenges related to health care services. For instance, lack of quality and quantity of human resources, equipment and medicines do not make the situation easy, and makes it especially important to

distribute these scarce resources in an appropriate manner. Essential to equity, fairness and effectiveness in resource distribution are well functioning HISs. Therefore, strengthening HISs in developing countries is getting much attention.

However, although advantages of ISs are seen as potentially significant, literature provides numerous examples regarding failure of realizing this potential (Sauer, 1993). According to Heeks et al. (1999), observations from the HIS domain indicate that similar challenges are experienced there. Supported by other literature (Korac-Boisvert and Kouzmin, 1995; James, 1997; Heeks and Davies, 1999), they even claim that most HISs are failures for their target context.

In addition, research shows that introduction, or improvement, of HISs and ICT in general in developing countries is facing an especially complex set of challenges. These are stemming from the health sector itself in particular, and from the country's context in general. This makes introduction of ICT in the field particularly complicated (Sahay, 2001). Due to the high importance and potential of, and the extensive challenges faced in, health information systems development in the developing country's context, donor communities and academia are continuously giving the field stronger focus (Korpela et al. 2000, Mursu et al. 1999; Heeks et al., 1999; Heeks, 1999; Heeks, 2002; Soriyan et al., 2001).

Nevertheless, stronger focus does not always mean appropriate focus. Different initiatives, often donor driven, have been promoting disparate HISs to satisfy their particular needs or to demonstrate accountability (Cassels and Janovsky, 1998). However, these types of approaches have in very few cases provided the adequate technical capacity to carry on; leaving behind a "localized" system not able to adapt to organizational changes nor able to satisfy more local needs (Braa et al., 2004). These types of systems, in the literature called Legacy Systems (Bisbal et al., 1999; Tromp and Hoffman, 2003), then need to be addressed appropriately to be dealt with in a proper manner. Understanding the challenges faced in addressing these legacy systems then becomes important when resolving their problematic aspects is sought for.

Mozambique is facing similar challenges for their HIS as described above. For instance, according to Aanestad and Chilundo (2004) donor efforts have resulted in several health program specific HISs causing redundancy and higher workload on health staff. They identified three different HISs regarding Malaria and three different for HIV/AIDS. HISP in Mozambique is an actor trying to facilitate change and improvement of the Mozambican health sector and its HISs. The HISP project in Mozambique, within which this thesis is based, was initiated in 1998. During the time the HISP project has existed in Mozambique, the Mozambican Ministry of Health; MISAU[1] has officially adopted objectives of the WHO (WHO, 1995) recommendations regarding decentralization of the organization, and towards action-driven district based health information culture, which also align well with the HISP philosophy. In the document "Programa de Desenvolvimento do Sistema de Informação para Saúde, 2003-2005 (2010)"[2] (PDSIS) from November 2003, MISAU

[1] MISAU is an abbreviation for "o Ministerio da Saúde de Moçambique" which means "the Mozambican Ministry of Health".
[2] The Program for the Evolvement of the Health Information System.

acknowledges the HISP approach and the DHIS software as the way forward for their HIS.

However, although change has been on the agenda for numerous years in the Mozambican health sector, few changes have been observed in practice. For instance, Aanestad and Chilundo (2004) observed no effect from several plans and initiatives for improvement of the organization and HISs, originated from MISAU and donors, at peripheral levels. Systems which do not support organizational needs are still embedded in the organization. In this thesis I will address challenges faced when trying to improve these systems and/or replace them with other, more supportive systems. By formulating and investigate the following research objectives I hope to gain better insight in the problem area:

Research objectives:

Investigate conditions for improvement of Health Information Systems in a developing country's setting

This is the general research objective for the thesis. As seen above, change seems to be hard to accomplish in the Mozambican health sector. I wanted to study this closer. The HISP project is aiming at both developing and implementing appropriate technical systems and social practice for a HIS. Participating in these efforts gave me the chance to investigate the challenges from the "inside". However, to be able to understand existing challenges properly, literature suggests that the history of challenges should be studied as well (Aanestad et al., 2005; Hanseth, 2002). I worked with improving HISs for the Mozambican health sector, and hence I also had to study the existing systems and how they are, and have been, relating to the organization, and the organization to them. This leads me to formulate some specific research objectives to assist my study:

- *Study how ISs may function as enablers and/or constrainers for social practice taking into account social systems heterogenic and non-static characteristics*

By studying several of the systems relating to the Mozambican health sector, better comprehension of conditions regarding ISs supportiveness for a social system may be reached. These conditions may also have consequences for how to address poorly functioning systems, work practices and support structures. .

Several efforts for improvement of ISs are going on, and have been carried out the past years in the Mozambican health sector. The work I participated in while I was in Mozambique represents parts of these efforts. I will study these processes in relation to dealing with legacy systems problems that have been present for many years. Maybe these processes can provide clues regarding typical challenges in change efforts. This leads to the other sub-objective for the study:

- *Study challenges of dealing with ISs that are not supporting the organization*

For better comprehension of the problem area I will make use of existing theory and literature to support my study.

Theoretical overview for the research

To inform the research appropriately, I developed a theoretical foundation where the complexity of the research setting is taken into consideration.

The theoretical focus of the research will build on an acknowledgement of that ISs are best understood as social systems (Walsham, 1993). The social systems view suggests that, because of the interconnectedness of technical, social and contextual factors, these should be taken into consideration for better comprehension and predication of impact of technology on the social system and vice versa. Social conditions where technology is going to be introduced are probably non-trivial. By developing a structurational social systems view some conditions for ISs supportiveness may be understood. In addition, acknowledging the IS as an integral part of a social system will also influence appropriateness of different design and development strategies. For instance, since an IS is meant to support organizational needs, social practice among users in the organization should be taken into consideration in IS development. Participatory design and prototyping approaches typically address this. However, successful IS design, development and implementation is highly conditioned by contextual characteristics. I will look more into what common literature say about developing country's contexts and ISs, HISs, and typical challenges in change efforts caused by existing technology and social practice. Legacy Systems Theory and the conception of the Installed Base are typically dealing with the latter types of challenges.

Empirical foundation of research, and research methods

The research presented in this thesis is concerning efforts I took part in under the umbrella of the global action research project HISP. My studies were carried out in Mozambique, and I will report from research I did as a member of the Mozambican HISP team. I was an active participant of HISP Mozambique at my two stays from March to June 2004, from July to September 2004, and after my return to Norway until the beginning of 2005. Towards the end of my thesis writing; December 2006, I went to Mozambique a last time for research and work.

As a HISP member I worked with situational analysis of the health system, design, development and implementation processes. This was done by following a typical action research approach, where efforts to improve the system are used as an approach to better understand the system, challenges and overall context. The study was informed by qualitative research methods. A conglomerate of data collection methods were drawn upon, facilitating a deeper and broader understanding of the problem area.

At three occasions I travelled from Maputo (the capital) for field studies among health staff and management. In March 2004, I followed a two-week field trip with an International Master Students Program arranged by HISP. In August 2004 two other

HISP team members and I went back to Inhambane to hold courses for health management for the whole province and for finalizing and implementing a customized version of the DHIS[3] application. We stayed there for 10 days. In December 2006 two other HISP team members and I went to the province office of the Maputo Province for interviewing health management about their HISs and use. Negotiation for appropriate software solutions and implementation strategies were done at several different levels in the HIS hierarchy, mostly in MISAU and with province health management.

Expected Contributions

This thesis aims at contributing both theoretically and practically to challenges faced in design, development and implementation of HISs in developing countries.

Theoretical contributions:

- Better comprehension of how HISs may support the heterogeneous social system interacting with them
- Better comprehension of how social structures may influence processes of dealing with legacy systems.

Practical contributions:

- By understanding legacy systems and their challenges better it should be easier to make strategies for how to deal with them.
- Specifically, I participated in several efforts for improving the HISs in the Mozambican health care sector by enabling replacement of existing legacy systems, tutoring new, local HISP team members, and training of health management.

Limitations of the research

The study was conducted in a developing country's context which might influence the validity area of the research, as these contexts typically have their peculiarities and special challenges (Sahay, 2001). It is to be noted that I did not study the whole Mozambican national health care organization. It is a big and complex organization, and such a study would probably go way beyond the limits of a master thesis. This study deals with parts of the organization where HISP Mozambique has been involved, with specific focus on what was on the agenda during my active time of action and research as a member of the Mozambican HISP team.

The systems which were dealt with were mostly routine health information systems, which may also contribute to the validity area of the research. For instance, a bank transaction system may have other typical requirements than those which are meant to serve the highly heterogeneous organization of health care.

[3] DHIS is the HIS tool of HISP

Structure of the thesis

From here the rest of the thesis is structured as follows, divided into three main parts underlining the intention of each part:

Part I Literature Review and Methodology

Chapter 2 Literature Review
Presentation of a theoretical framework relevant for my research will be provided

Chapter 3 Methodology
Presentation of methodological framework, with methods used for data collection is described

Part II Empirical Enquiry

Chapter 4 Background
A summary of HISP in general, a short presentation of HISP Mozambique, and an overview of the HIS toll DHIS will be presented. In addition, a short presentation of Mozambique will provided.

Chapter 5 The Mozambican health system; Situational analysis
Then important characteristics of the Mozambican health system with its HISs, typical routines among health management etc. will be addressed. Here findings will be a mixture of the research I actively participated in, and from other findings and research done by others at earlier stages. This is because much research has been done in the Mozambican health domain already. What is already known, however important for my research, will not be presented as new although I investigated some of the same areas.

Chapter 6 Systems development; Technical issues
Here I will present systems development which has been done by HISP Mozambique. The first part of the chapter deals with what was done before I arrived, and the rest of the chapter with what I participated in. The point is to get a clearer view of HISP processes in Mozambique over longer time.

Chapter 7 Implementation efforts
Here I will present implementation efforts which have been done by HISP Mozambique. The first part of the chapter deals with what was done before I arrived, and the rest of the chapter with what I participated in.

Chapter 8 MISAU; Challenges and Politics
Here I will present political interventions and challenges which have been dealt with by HISP Mozambique. The first part of the chapter deals with what was done before I arrived, and the rest of the chapter with what I participated in.

Chapter 9 HISP Project Management
Here I will present some typical aspects of HISP Mozambique. The first part of the chapter deals with what had happened before I arrived, and the rest of the chapter with what I participated in.

Part III Discussion and Conclusion

Chapter 10 Analysis and Discussion
In the light of the literature review, the case will be analyzed and discussed with a focus on addressing the research objectives.

Chapter 11 Conclusion
Research findings are summarized, and future research indicated

PART 1 LITERATURE REVIEW AND METHODOLOGY

2 LITERATURE REVIEW

This thesis is about understanding and addressing legacy systems challenges, in particular legacy challenges of information systems, with a case study from the health care domain in a third world country's context. To better understand the socio-technical composition of challenges presented in the thesis, I will draw upon existing literature which may provide assistance in the analysis.

Primarily I will present theory and important aspects regarding routine health information systems, district based health information systems and primary health care. The HISP philosophy builds much on experience and theory in this domain, so understanding it is important if comprehension of HISP approaches to HISs is to be obtained.

Drawing upon the acknowledgement of the value of understanding both social and technical aspects of organizations in IS design, development and implementation processes, I will position the research with discussing theory emphasizing looking upon ISs from a social systems point of view. With Structuration Theory (Giddens, 1984) an additional dimension to the problem area may be addressed, caused by its integrated approach to structures and human agency.

In the light of acknowledging the social systems view I will then look at theory dealing with IS design and development processes. Towards the end of the chapter I will present how ISs and IS design, development and implementation typically may be challenged by contextual conditions.

Sections:

2.1 Health information systems

"Without reliable, relevant health information, health care managers and providers cannot optimally allocate resources, improve the quality of health services, or address epidemics such as HIV/AIDS. […] As health systems around the world are being re-structured, the demand for sound information and the skills to manage and use information are increasing significantly. All countries need a national HMIS at least partially based on modern ICT technologies linking the various levels of the health system and addressing the information needs of policy makers, managers, health programmes, service providers, staff, and increasingly patients." (WITFOR 2003)

Definition

Health information systems (HIS) are defined by Boerma as:

"A combination of people, equipment and procedures organized to provide health information to health workers (and others) in a way that enables them to make informed decisions." (Boerma 1991 p.126)

Heywood, Campbell, and Awunyo-Akaba (1994) suggest that HISs should be looked upon as tools for improving health care, and not as ends in themselves. HISs should support and improve health care by increasing efficiency, quality and scope of the services through more efficient planning, organisations and management functions (ibid.).

Lippeveld and Sauerborn (2000) argue that HISs should support the following actions:

- Collection of data
- Transmission of data
- Processing of data
- Analysis of data
- Presentation of data
- Information use in planning and management

Different types of health information systems

There are mainly two types of HISs:

- Clinical health information systems
- Routine health information systems

Clinical HISs are typically large and complex hospital information systems which focus on patient specific data. These advanced hospital systems have proven to be difficult to develop and implement both in industrialized and third world countries, and the failure rate for such systems seems to be very high (Littlejohn, Wyatt and Garvican 2003, Heeks and Bhatnagar 2001).

2.1.1 Routine health information systems

The focus in my thesis will be on routine health information systems. Routine health information systems are by the Routine Health Information Network defined as:

"*Information that is derived at regular intervals of a year or less through mechanisms designed to meet predictable information needs"* (RHINO, 2002, p.2).

Examples of routine health information systems are:

- Health service statistics for routine services reporting and special program reporting (e.g. malaria, HIV/AIDS, and TB)
- Administrative data (personnel, drugs, training, research, documentation, financial administration etc.)
- Epidemiological and surveillance data
- Data on community-based health services
- Vital events data (births, deaths, and migration)

Routine health information systems are meant to give information for planning and management, as they will empower managers' and practitioners' possibilities to identify problems as they arise, and then problems can be easier solved. In Lippeveld and Sauerborn (2000) it is stated that health care information systems should permit generation of the necessary information for rational decision making at each level of the health system as each level has specific functions that require specific decisions to be made.

However, much evidence point to that routine health information systems around, in industrialized countries as well as in third world countries do not function appropriately, as they do not provide the adequate information needed to support health care activities and individual care (Lippeveld, 2002). Several reasons for this are reported repeatedly in the literature (Lippeveld, 2002):

- Data on individual health care activities are irrelevant and of poor quality
- Information on health care interventions is not linked to a reference population
- Information system management is often heavily centralized
- Health information infrastructure is inappropriate in most third world countries

The RHINO 2002 workshop made a statement on how a routine health information system should be developed:

"The restructuring of routine health information systems should involve all key stakeholders in the design process. Experience suggests that systems that are designed by a team of "information experts" without adequate involvement of key stakeholders usually fail to reflect the needs and practical reality of service providers and managers, and does not encourage ownership of systems." (RHINO, 2002, p.3).

2.1.2 Primary health care and district based approach

Until the middle of the 20th century health care in the third world consisted largely of attempts to import hospital-based health systems, trying to replicate what had been developed in the first world (Braa, 1997). Though, by the 1950's planners and administrators worldwide were realizing that this approach to health care had failed (Moll, 1990). In 1978, at an international conference in Alma Ata with WHO and UNICEF the concept of Primary Health Care (PHC) was introduced. The Alma Ata Declaration presented a comprehensive approach to reach the WHO goal of "health for all by the year 2000" (WHO, 1978). With the introduction of the PHC approach

focus was shifted from the larger hospitals and curative health care, to local health centres and preventive health care. The Alma Ata declaration describes the concept of primary health care:

"Primary health care is essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination. It forms an integral part both of the country's health system, of which it is the central function and main focus, and of the overall social and economic development of the community. It is the first level of contact of individuals, the family and community with the national health system bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process." (WHO 1978, Article VI, p.1).

The concept of PHC was criticized for being too comprehensive and ambitious, and difficult to implement. Several national attempts following the PHC approach following the Alma Ata declaration failed. An explanation given for failure was that the countries were too large for central management of the expensive and complex tasks of the approach (WHO, 1995). As a consequence a debate between a selective and a comprehensive approach aroused (Braa, 1997). The selective approach supported a more narrow view on the PHC approach, where the focus was on selective, vertical and fragmented health programs. Opponents of this, the supporters of the comprehensive approach criticized the selective approach for not being able to create sustainability, and emphasized the importance of community empowerment with a focus on process, with the need for multi-sectoral approaches (Rifkin an Walt, 1986; Newell, 1988).

With the above in mind several workshops and discussions regarding the PHC concept led to the Harare Declaration. The declaration demanded intensified primary health care in a well-organized district health system. The health district should be the main core unit of the PHC approach (WHO, 1995).

WHO (1995) identified some characteristics of a health district:

- A defined administrative area with a population of approximately 50 000-300 000
- A segment of the national health system
- Comprising all facilities and individuals in the district that are involved in health care, not only governmental, but also charity, church, and private health care providers
- Vertical health programs, e.g. immunization, family planning and HIV/AIDS control, should be coordinated with horizontal health services and integrated as far as possible, at least at primary level

Amonoo-Lartson et al. (1984) reflect the importance of the local varieties in which the setting the PHC approach is to work:

"Countries and communities vary in terms of size, geography, climate, population, communications, level of political, economic and social development, health needs and resources, and local leadership. Systems of providing health care need to be evolved which meet each locality's circumstances and problems." (Amonoo-Lartson et al, 1984 p.15)

They also suggest an approach on how to handle the variety:

"Development of "Bottom-up" as opposed to "Top-down" planning i.e. taking the needs, resources and opportunities in local communities as the starting point for planning health services, as apposed to planning on the basis solely of needs and policies as seen as the national level." (Amonoo-Lartson et al, 1984 p.16)

2.1.3 District-based health information systems

The WHO (1995) emphasizes the importance of the health district as a base for the PHC approach. The health district should integrate all local health activities, and an information system supporting this for the district is seen as most appropriate. So, a routine health information system should be able to include all the local health activities in an integrated manner.

In a HIS, data is typically collected at facility level (lowest level) on a daily basis, and then routinely reported to the district information centre. Reporting frequencies can be daily, weekly, monthly, quarterly, semester based, or based on once per year. The reporting frequency in PHC is normally monthly. Ideally the district information centre should integrate all relevant health information within the district, and it should be responsible for reporting upwards (RHINO, 2002).

The PHC approach emphasizes the importance of analysis and the immediate use of information at every level in the HIS hierarchy (Obit, 1987). This is in opposition to the traditional HIS, where a focus on retrospective analysis from higher levels has been the trend. Sandiford et al. (1992) indicate that, while the traditional HISs have tendencies of being **data-led**, meaning that data is an end in itself, an **action-led** approach, where information is actively used to influence decisions and actions, is the most appropriate for an HIS supporting the PHC approach. A typical property of a data-led approach is that it is designed for the central levels needs for control and monitoring, and data requested are "shipped" though the system without much analysis on the way. In contrast, in the action-led approach data collected is ideally only what is needed for appropriate management and decision making, with a focus on the use of denominator data as e.g. population data as a part of making action driven indicators (Sandiford et al, 1992). This means that just minimal amounts of data are collected and a greater focus on important data for more effective and targeted analysis of action-led information is facilitated.

Due to local variations found among different health districts, Braa et al. (1997) stress the need for **locally adapted** HISs for districts, much in line with Amonoo-Lartson et al. (1984). A challenge can then be to integrate these local adaptations to a national consistent HIS. To be able to achieve such integration national standards will be essential, and then one should find a balance between them and the local adaptations.

Aggregation of data is seen as sensible for better efficiency in paper based systems, as detailed data will require much consumption of time and resources at top levels if reported though the whole system. The workload is instead put on the lower levels, making them facilitate upper levels' needs of aggregated data. In an appropriate computerized system functioning at lower levels the calculation for aggregation of data can be done automatically, and then satisfy all needs of different aggregation levels, as detailed data often is less necessary at the highest levels than at lower.

Local use of information is seen as important for a successful move towards the district based PHC approach. A common problem with HISs is that they are typically designed for facilitating top level's needs for monitoring, while they do not specifically enable data use for local decision making. The HISs will then rather be a means for maintaining bureaucratic or organizational power (Sahay, 2001; Opit, 1987).

As a part of a decentralized HIS is also a decentralized power structure enabling local decision making. Braa (1997) emphasizes the importance of involving local role-players in the process of defining goals, targets and indicators, so they are a part of achieving the set targets.

2.2 Understanding Information Systems

In this section I will develop a perspective on how ISs may be viewed upon to be understood in an appropriate manner regarding their role in the social context, and the social contexts role for ISs.

2.2.1 Information systems as social systems

Characteristically, traditional research on ICT look upon information systems as discrete technological artefacts, like an information processing application, and where its use has a predefined and direct effect on the environment where it is implemented. Numerous of cases show, however, that this pure technological view on information systems has lead to plentiful of failures, and its predefined and expected effects have not always been realized in practice (Kling et al 2000).

Kling and Scacchi (1982) provide so-called web models as a theoretical framework for understanding why and how large ISs have a tendency to be tied to the social context through a web of associations. The web model is proposed in opposition to what is described as discrete-entity models which represent a commonly view that ISs are basically neutral technical systems. The difference in perspectives is described as follows:

"*When an analyst uses a discrete-entity model to understand the computing capabilities of an organization he usually begin by asking; "What kind of equipment and facility do they have?". In contrast, analysts using a web model begin asking: "What kind of things do people do here?""* (Kling and Scacchi, 1982, page 9)

By building on the web models Walsham et al., (1990) state that large ISs are best understood as social systems. ISs understood as social systems, meaning that they consist of much more complexity than represented by simple technical artefacts and software, gives clues to that ISs are typically difficult to change.

Social informatics is a term for research which relates to the social aspects of ICT. For better comprehension and predication of impact of technology both social and technical factors have to be taken into consideration. Social conditions where technology is going to be introduced are probably non-trivial. Because of this, the effect caused by the ICT will be very hard to predict. By gathering empirical data from both successful and failed projects, better understanding for reasons behind the outcomes may be reached. This again, may develop and improve further practice.

Influence of technology on the social system, or organization, is not one way only. Sawyer and Rosenbaum (2000) claim, in a summary of findings around social informatics, among other things:

- **ICTs follow trajectories and these trajectories favor the status quo.** The configurable ability of ICTs is underlain by the trajectories of the components. A trajectory means that any definable component can be seen as an evolving series of products (or versions). That is, they have a history and a future. And, the status quo means that preexisting relationships of power and social life are often maintained and strengthened. Since ICTs are socio-technical entities, their evolution is as much social history as technical progress.

- **ICTs co-evolve during design/development/use (before and after implementation).** Configurable ability of ICTs also underscores the socio-technical process of ICT design, development and use is reflected in every stage of an ICTs life. A system's use unfolds over time in a form of mutual adaptation between the ICT and the social system into which it has been placed. This ever-unfolding process, a "design in use", also implies the variations in social power that define much of the discourse between ICT developers and ICT users.

2.2.2 Structuration Theory and information systems

I will first present some aspects of ST (1984) as it introduces a framework for comprehension of social practice. Enhanced comprehension of the social structures in processes of design, development and implementation of ISs is important for better understanding how they affect these processes and outcome. Although Giddens has not explicitly dealt with ISs in ST (1984), several papers are published in the IS domain where researchers have used or developed their own appropriation of the theory. I will address the role of an IS as a part of the social system, and the implications the constitution of social systems have for ISs ability to support the social systems they are a part of.

ST is developed as an alternative to social theories which claim that individual action can be explained from structural conditions, and the theories which emphasize the individual agents' possibilities to construct and reconstruct the context where they are

situated within, and act independently of structural conditions (Korsnes et al, 1997). ST provides a framework of concepts to study the interaction and mutual arrangement of human agency and social structures. Without going into all details of ST I will present some basic concepts which are also central in my study.

Structure

In ST, structures are defined as *"rules and resources recursively implicated in social reproduction"* (Giddens, 1984, p.6). Further Giddens states that: *"Social structures exist only in their instantiation through social practices. At the moment a structure no longer is reproduced in human practices in a region of time-space it seizes to exist in that region"*. An important distinction from a more common view of structure, is that Giddens regards structures as both enabling and constraining, e.g. in the same way as languages (being social structures themselves), are grammatically and phonetically limiting, while they at the same time enable communication. Giddens refer to structures in social analysis as "the structuring properties allowing the "binding" of time space in social systems, the properties which make it possible for discernibly similar social practices to exist across varying spans of time and space which lend them a "systemic" form".

Human Agency

Human agency in ST is connected with the power of the agent, or "the capacity to make a difference". The "amount" of this ability is defining the agents "transformative capacity". Giddens explains power through two different means: authoritative resources; ability to coordinate activity of other agents, and allocative resources; ability to control material products or aspects of the natural world.

Duality of structure

According to Giddens (1984, p. 25) *"The structural properties of social systems are both medium and outcome of the practices they recursively organize"*. This is what he calls the duality of structure.

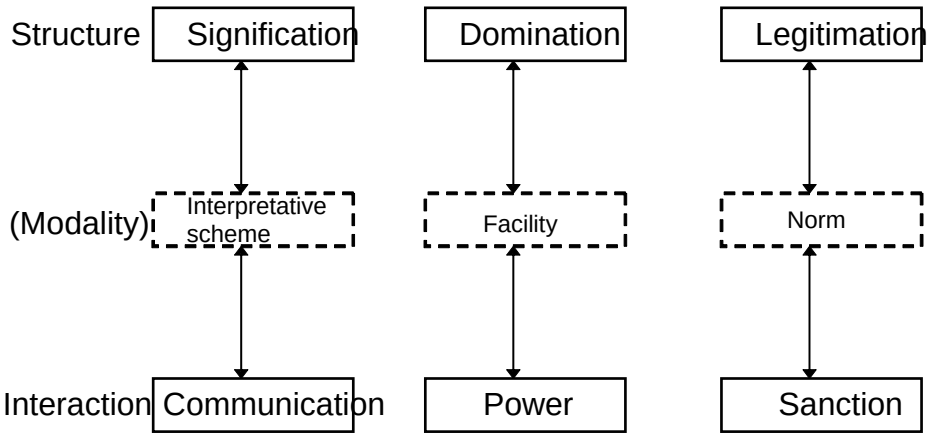


Figure: Analytical dimensions of structuration theory (Giddens, 1984)

The three dimensions (for analytic purposes only) of social structure and human interaction illustrate the recursive character of structuration linked by the modalities. As human actors communicate, they draw on interpretative schemes to help make sense of interactions; at the same time those interactions reproduce and modify those interpretative schemes which are embedded in social structure as meaning or signification.

Structuration and time-space distanciation

Structuration is defined as "*the structuring of social relations across time and space, in the virtue of the duality of structure"* (Giddens, 1984, p.376). Structuration is hence the process where the duality of structure evolves and is reproduced over time space. Agents in their actions constantly produce and reproduce and develop the social structures which both constrain and enable them. Time space distanciation so means the "*stretching of social systems across time-space, on the basis of mechanisms of social and system integration"* (Giddens 1984 p. 377). If social practice becomes reasonably stable over time and space, then routines - practices in which actors habitually engage - develop. Routines constitute "*the habitual, taken-for-granted character of the vast bulk of the activities of day-to-day social life."* (Giddens 1984 p. 376).

Unintended consequences of structuration

However, Giddens emphasizes how intentional behavior also has the potential of unintentional outcome, underlining the difficulties of control and prediction of social systems: *"The knowledgeability of human actors is always bounded on the one hand by the unconscious and on the other by unacknowledged conditions/unintended consequences of action. Some of the most important tasks of social science are to be found in the investigation of these boundaries, the significance of unintended consequences for system reproduction and the ideological connotations which such boundaries have."* (Giddens, 1984, p. 282). *"Social activities are acted out through purposive action that leads to unintended consequences."* (Giddens, 1984, p. 294).

Dimensions of social change

Giddens (1984) describes a model as a basis for change in social systems. He draws up the "dimensions of social change", and splits it into the following bases:

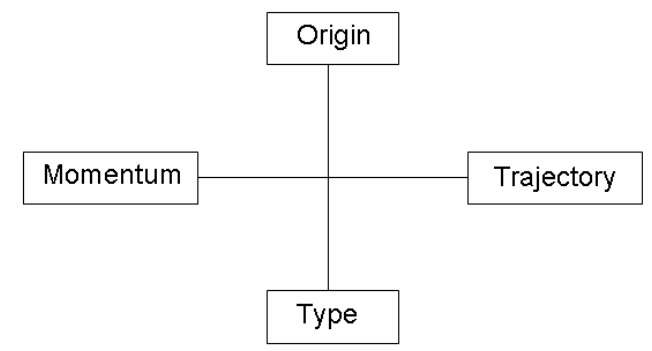


Figure 1: Dimensions of social change (Giddens, 1984)

At any time and place a social system in change has an origin, meaning it must change from something. How the changes are materialized can be described through their trajectory, type and momentum.

2.2.3 Structurational framework for ISs and social change

Structuration Theory gives some implications regarding how ISs may support (or not) an organization and organizational change.

The IS as an enabler and constrainer for social practice

Walsham (1993) presents a framework for analysis which uses ST to connect the social context and the social process. He argues that an IS may be seen as the linkage between context and process:

"A theoretical view of computer-based information systems in contemporary organisations which arises from structuration theory is that they embody

interpretative schemes, provide co-ordination and control facilities, and encapsulate norms. They are thus deeply implicated in the modalities that link social action and structure, and are drawn on in interaction, thus reinforcing or changing social structures of signification, domination, and legitimation." (Walsham 1993 p.64)

This means that an IS could be seen upon as something which is created to support particular human practices in specific structural contexts. As well, the designers' assumptions of how a technical artefact will be used will shape the design. In this way the IS embody certain programs for use. For an IS to enable and support certain social practice, it must then have embedded this very practice. If this is not supported, it will set constraints for potential social practice.

context	meaning	power structure	norms
(IT role)			
action	communication	use of power	sanctions

Figure 2: IS role in structuration processes according to Walsham (1993), (from Rose and Lewis, 2002).

However, because of transformative capacity which human agency embodies and unintended consequences of intentional conduct, social systems are enabled for change. Giddens' (1984) framework for organizational change provides an explanation of how structuration processes, and hence the social system, follow changes in trajectories, their degree and their momentum (see Figure 1). The implications for ISs, taking into account their role as a "modality" in structuration processes, will then be that the ISs themselves must be enabled for change. Thus, to be able to maintain the enabling and supportive properties for the social system they must follow change in social practice in its direction, extent and speed.

In addition, according to Giddens (1984), these structuration processes are stretched across *time* and *space*. ST suggests that the constitution of society is an accomplishment of its members without being wholly intended or comprehended. This realization accounts for the complexity of social systems and implies that generalizations about social phenomena are temporally and spatially bounded. This means that social practice has uncertainties in the time dimension, but also in the locus dimension at a certain time. The implications for ISs will then be that they need to be able to support variations in social practice both in the *time* dimension, and *locus* dimension at a certain time to not function as constraints.

2.3 Information Systems and Development Processes

The traditional view of ISs as being discrete technological artefacts having a predefined and direct effect on the target context has as well formulated how systems development processes typically have been shaped. For instance, the waterfall model for systems development has the view of ISs being discrete-entities embedded (Sommerville, 2001). Development processes are constituted of clearly defined phases, and the system is developed on the basis of a set of predefined requirements.

However, the social systems perspective presents another picture of the IS role for the target context. For instance, as seen above, Structuration Theory gives several implications for how an IS may enable and support social practice in an organization. This also gives implications for how systems development processes should be viewed upon. The tight connection between ISs and social structures which Walsham (1993) suggests, implicitly make consequences for how a system may be designed and developed to support social practice. Systems design and development need to take into account and be highly aware of the target social system and organization to elevate the probability for the IS to be supportive to real needs. In addition, by taking a structurational view of social systems, it becomes evident that, as social structures are only instantiated through social practice, they are enabled for change through human agency. Change in the social system is typically an explicit goal when introducing new ISs into a context (Heeks et al, 1999).

2.3.1 Participatory design

Participatory design does explicitly take into consideration the social system of the target context for the IS. Participatory design means that users are involved in design processes of ISs. Involving users in IS development processes, is seen to be a very important factor influencing implementation success, or failure (Wong & Tate, 1994).

Users participating and influencing design often develop a supportive relationship to the system, and thus participatory design is seen as an appropriate method to counter resistance to change in organizations (Carnall, 1986; Gregory, 2003). As well, the developers gain more knowledge about the environment, which then forms the basis upon which systems are built (Gregory, 2003).

The Scandinavian participatory design traditions distinguish themselves from participatory design in general by three principles (Gregory, 2003):

- deep commitments to democracy and democratization
- discussions of values in design and imagined futures
- conflict and contradictions are regarded as resources in design

According to Gregory (2003), Scandinavian approaches are not distinguished from other participatory design by its methods, but rather by its political commitment to societal concerns and relationships with participating users and communities.

Scandinavian participatory design approaches emphasize in addition to technological change, the changing of the whole social system (Gregory, 2003). Therefore, employees collaborating in participatory design processes *"…must have access to relevant information, they must have the possibility for taking an independent position on the problem, and they must in some way participate in the process of decision making"* (Kensing, 1983:223).

Braa (1997) strongly suggests application of a social systems perspective in systems development in developing countries, and refer to the potential of Scandinavian participatory design traditions to incorporate a social systems view in the development process.

Heeks et al. (1999) point out various factors limiting the value of participation in typical third world contexts. They argue for that participatory design processes must be approached critically, without the assumption that they always will give profit. A number of special social systems characteristics where user-participation techniques are unlikely to work appropriately are listed (Heeks et al., 1999, p. 20):

- Users lack information about participative techniques and about the new information system
- The objectives of senior staff are not to share power and the values of the organization are authoritarian and hierarchical
- Users lack the skills and confidence necessary to engage in participative processes
- The management style and organizational structures of the organization are highly centralized
- The organization lacks the time and money to invest in participative approaches

Participatory customization

Kimaro and Titlestad (2005) acknowledge the potential challenges of reaching effective participatory design interventions in typical third world contexts. The initial technical capability of users, motivation and desire to participate, availability of resources and long-term support mechanisms are often taken for granted in the West, where participatory design methodologies have their origin, but are in many cases not present in the context of third world countries. They argue that in settings where for instance computer skills are low, a better strategy could be participatory customization. However, this means that a system partially finished, or relatively easily customizable, needs to exist beforehand.

2.3.2 Prototyping

Grudin (1991) argues that traditional development methods as for instance the waterfall model, typically being constituted by a one-directional sequence of phases from requirements to final implementation do not embody the appropriate flexibility to cater for user involvement and new requirements that may come up at any stage in

development processes. For user participation to make sense the development method must be sensitive to user feedback, and preferably at all stages of the development process. Prototyping as a development method supports such an open development process, and is by this seen upon as an important means in participatory design.

The UTOPIA project utilized mock-ups as a form for prototyping. After that, prototyping has often been an integrated part of Scandinavian participatory design approaches. Prototyping was used to make the systems design process more participatory and democratic (Spinuzzi, 2002:208). Being two models for prototyping used in Scandinavian participatory design processes, Mock-ups and Cooperative Prototyping were explicitly dealing with bringing tacit work knowledge into the design process. Pape and Thoresen (1986) emphasize the importance of a trial and error process facilitating testing of different solutions to solve potential problems that may arise.

According to Braa and Hedberg (2002), in DHIS development processes in South Africa, any interested or innovative user at any hierarchical level in the health sector was let to give inputs to the processes. They claimed that a more formal approach would be unfeasible or unproductive within the heterogeneous organizational structure in which HISP operates. This is breaking with typical prototyping as it is described in the literature, which tends to be fairly formally ordered, with well established user groups and means for communication. However, the development team normally had to guide users to a significant degree in understanding their own requests and how the requests may be implemented (ibid.).

2.3.3 Cultivation

Dahlbom and Janlert (1996) propose the conception of cultivation as opposed to construction in IS development. Construction is viewed as selecting and arranging a number of objects to form a system. However, cultivation means interfering with, support and trying to control natural processes (Hanseth, 1997). As a concept it points out the limits of steered human control of a process taking place in a complex setting of the social system. Cultivation should rather be seen as a long-term progressive change effort of social systems [*Installed Ba*se] (Hanseth and Monteiro, 1998), as social systems are not stable foundations on which ISs can be constructed in a fully controlled manner.

Information systems are never developed into a void. The legacy, ranging from existing information systems to social and cultural patterns, will always form the point of departure. In a HISP development project in South Africa, Braa and Hedberg (2002) applied a design strategy based on cultivation:

“By cultivation, we mean a slow incremental bottom-up process of aligning actors by enabling translation of their interests and gradually transforming social structures and information infrastructures where the resources already available form the base.” (Braa and Hedberg 2002 p.5)

2.4 Information Systems and Development Context

By looking upon ISs as integrated parts of the social system, one acknowledges that IS design, development and implementation are conditioned by social structures and already existing technical systems of the setting wherein the new IS is to be introduced or changed. Structuration Theory gave implications for ISs in the social system, as there have to be a certain alignment between the IS and social practice for appropriate functioning of the IS and/or social practice. Several challenges in the target context might meet ISs regarding design, development and implementation. I will here present some theory which deals with typical challenges.

2.4.1 HISs in a developing country's context

In third world country's contexts HIS initiatives usually encounter several challenges stemming from the general conditions of the context. A typical problem is the poor infrastructure, in terms of communication, patient care and human resources (Sahay, 2001, p. 1). Main problems regarding IS projects in developing countries are listed in Mursu et al. (2000, p. 5):

- Inadequate infrastructure, most noticeably poor power supply and telecommunications.
- Shortage of skilled personnel. There is lack of technical skills and IS professionals and managers educated in managing complex ISD processes. The education emphasizes software engineering instead of information systems development. Thus, "systems developers in Africa work under severe practical constraints but are less adequately trained to cope with them, compared to their colleagues in industrialized countries".
- Unsupportive public sector culture as well as colonially inherited administrative culture, comprising over-politicized decision making processes, bureaucratic complexity, and preference for informality.
- Several African countries have grave economic and political problems which cause insecurity of life and uncertainty of future, a formidable hindrance to long-term initiatives like ISD.

Braa (1997) points to inadequate IS experience as a central limitation for HIS diffusion. Support structures must often be initiated during development processes.

Bureaucracy

According to Sahay (2001) health systems in developing countries are typically challenged by strong bureaucratic tendencies of the organizations. He emphasizes the complexity of organizational surroundings as an important source of HIS development problems. Normally health care is driven by the state, and is imbued with bureaucracy:

"Health care workers spend a significant proportion of their working time filling out a multitude of forms and reports and sending these "upwards" to the districts,

provinces, state, national and international levels. While this focus on reporting serves to fulfill the needs of the bureaucracy and their dependencies on international aid agencies, and certain of this information is important for epidemiological purposes, it is rarely ever used to guide local action at the level at which the data is collected. Data which could be fruitfully used at the local level to analyze trends and help develop interventions in cases of epidemics and to identify causes of various problems, is often (and regrettably) used by the bureaucracy for purposes of control and to reprimand hard working and already poorly motivated field staff. … Within this context, ICT introduction while providing the potential to shift the traditional focus from reporting to analysis will also confront the complexities of trying to change such strong and dominant traditions." (Sahay, 2001:2)

Information in these kinds of organizations typically takes on a meaning of its own, separate from its actual use. Research indicates that organizations have a habit of gathering more information than used in decision making processes (Feldman and March, 1981). In addition, characteristically much of the data collected are not relevant or/and used for decision making anyway. There is a belief that more available information means better decision making. Feldman and March (1981) claim that "*there is no institution more prototypically committed to the systematic application of information to decisions than the modern bureaucratic organization. The gathering of information provides a ritualistic assurance that appropriate attitudes about decision making exist. Within such a scenario of performance, information is not simply a basis for action. It is a representation of competence and a reaffirmation of social virtue."* (1981, p. 177).

2.4.2 Success and failure concepts for ISs

Historically it is noticed that many health information systems have a tendency to fail in what they are intended for (Korac-Boisvert, 1995; Heeks and Davies, 1999). Heeks et al. (1999) conclude that a successful HIS will have some certain properties regarding its environment where it is intentioned implemented. They say that a working HIS is one that "*tends to match its environment in relation to technical, social and organizational factors; these latter including the perceptions of key stakeholders*" (Heeks et al., 1999, p. 4). For more understanding and to better foresee how a HIS would behave in the context, they develop a tool for analyzing gaps between a current reality and the conceptions of a design of a HIS. The tool is called the ITPOSMO model, where 7 dimensions of potential reality – conception gaps are analyzed to better understand success/failure possibilities for a HIS.

- Information dimension
- Technology dimension
- Process dimension
- Objectives and values dimension
- Staffing and skills dimension
- Management and structures dimension
- Other resources dimension

Heeks et al. (1999) gives examples of some “archetypes” of reality – conception gaps that can make a failure of a HIS more likely.

Gaps between formal rationality and behavioural rationality are described from “hard” rational models assuming logic, formality and objectivity to be the ground for organizations. This is opposed to alternative “soft” behavioural models developed, where factors such as human limitations, social objectives and that subjectivity underlie the operations of an organization. Difficulties will then occur when hard rational design meets a soft behavioural reality in HIS development and implementation (Heeks et al, 1999). Heeks et al. (1999) say that if such gap is present, the behavioural realities must not be seen upon as simply “irrational”, since they may derive from logically consistent viewpoints - as individual differences, human cognitive or other limitations, or from other sources with the label “irrational”.

HISs are based on assumptions about the how the context where they will be implemented and work is constituted. However, if there is a gap between the context of design and of implementation, problems will arise (Heeks et al, 1999). Designers of HIS make certain assumptions that will be incorporated into the design of the system. These assumptions may be different from the reality, and the context design – implementation design gap will be present. When a HIS is developed in/for a country and then transferred to another, a typical country context gap can arise. Transference between an industrialized country and a third world country will can be especially sensitive for this, but also between two third world countries due to possible big structural differences etc. Private – public gaps can arise when a HIS developed for the public sector is transferred to the private sector, or vice versa.

However, Heeks et al. (1999) says that the success of an HIS is more probable if it matches the current structural context, but they are also aware of possible drawbacks of this. Typically, a new system will try to change what already is there to make improvements. Thus, the bigger gaps between the old and new, the bigger is the probability will be that it could be a failure. On the other hand, the more equal the new system is to the current context, the easier it may be adopted, but also fewer and/or smaller changes will be apparent.

2.4.3 Legacy systems

When doing ISs development it is in most instances not a question of attempting to introduce a system into a void. The system has to be implemented where there already are routines and other systems. When one so wants to replace these systems, the process will probably become more complex. The existing systems and routines around them are typically deeply woven into the social system already. In the third world HIS setting, one often finds systems of a certain character, so-called Legacy Systems. When trying to deal with such systems, Legacy Systems Theory is seen as a good tool. The theory defines and discusses certain typical challenges regarding these systems.

Definitions and properties of legacy systems

Tromp and Hoffman (2003) define a legacy system as *"an operational system that has been designed, implemented and installed in a radically different environment than that imposed by the current ICT strategy."*

According to Bisbal et al. (1999, p.1) legacy systems can be defined as *"any information system that significantly resists modification and evolution."*

In addition, Bisbal et al. (1999) and Ulrich (2002) indicate some problematic properties which are typical for legacy systems:

- Often run on obsolete hardware that is slow and hard to maintain
- Expensive software maintenance because of lack of documentation and knowledge about system details
- Integration to other systems is difficult due to lack of clean interfaces
- Difficult or impossible to extend

Legacy systems are typically old, and are *"generally wired into the running of a business in a very substantial way"*, (Robertson, 1997, p.40). Due to this embeddedness into the context, legacy systems are often resistant for being changed, thus giving a harder time to replace them. Because of the common importance of the systems for their target context means that they should be well understood, so that they can be dealt with in an appropriate manner when the aim is to solve the legacy challenges. Dealing with these systems is probably important, as if one compare how Heeks et al. (1999) define failure of systems with typical characteristics of legacy systems it is possible to see that there are gaps between which kind of social practice the systems are supporting and the needs of the organization.

How to deal with legacy systems

Legacy systems theory presents several strategies for how to deal with legacy systems. Bisbal et al. (1999) divide the strategies into the following three categories:

- *Redevelopment:* Rewrite existing systems. It is described as a redevelopment of the legacy system from scratch using a new hardware and modern software technology. The risk regarding failure is seen as quite high due to constant change in organizational needs. Thus, when the system is redeveloped, it might already have legacy tendencies for the organization.
- *Wrapping:* Wrap other new systems and functionality around the existing LIS, giving the old system a function as a server. Wrapping is seen as a short term solution and in addition probably problematic. By not actually removing the old system, many of its problems will still exist.
- *Migration:* Transfer the original legacy data and functionality to a more flexible environment. This would retain the original functionality and not disrupt existing routines much. The transfer would probably be smoother. Extended functionality could then be added at a later stage, making small changes at a time

It is noted that the solutions are open for combinations, as the techniques often are applied at component level, and not on the whole technical system. Ulrich (2004) explains the importance of having a wider overview to understand the implications of changing or replacing legacy systems: "*The legacy systems challenge must be tackled at an enterprise level because of the installed base of systems and related data is too interdependent to tackle from a one-department perspective"*.

Replacing legacy systems

According to Bisbal et al. (1999) the perceived most useful strategy for handling legacy systems is the migration method. They indicate several strategies for the transition from a legacy system to a new one:

- *Cut and Run:* Switching off the old legacy system and turn on the new system. The cut and run method is seen as quite risky. The organization is already dependent on the information the old system provides. If cut off, and the new system does not work as intended it may be critical for the organization.
- *Phased interoperability:* Gradual transition by replacing some components at a time. The old and new are typically connected utilizing gateway solutions. This method is seen as potentially highly complex, and thus risky, due to the typical nature of legacy systems.
- *Parallel operations:* Both systems are run in parallel until the new system is fully trusted. A disadvantage of this is that two systems ran in parallel probably means higher work load for the users. However, the risk involved with systems functionality is regarded as low, as there will be a backup system if the new does not perform as wanted.

According to Bisbal et al. (1999) no, or close to no, successful projects applying the migration approach to legacy systems challenges are reported, indicating the high difficulty of legacy systems replacement. The few projects reporting success are often based on ad hoc solutions which methods are hard to generalize. This means that trying to obtain better comprehension of such challenges should have relatively high relevance.

2.4.4 The Installed base and resistance to change

ISs are not just technical system implementations, but organizational interventions (Markus & Benjamin, 1996). Hanseth and Monteiro (1997) call this the installed base of the information infrastructure, which embodies standards, users, work-practices, technical components, etc. The installed base will enable and constrain technology and social structures of the development process and the new IS. For instance, Markus (1983) indicates that an IS design with embedded social practice matching the power structures of the target context is more likely to succeed than one requiring changes.

An important feature connected with the conception of the installed base is the installed bases characteristics of being uncontrollable. It is uncontrollable in the sense that no actors alone can control it fully, although several actors may influence it in a limited way (Hanseth, 2002). One of the reasons for its unmanageable characteristics is the fact that elements of the installed base are typically highly interconnected. Technology in an information infrastructure is looked upon as an uncontrollable entity, having organizational routines embedded into its design. Because of the routinized and embedded social practice and technical systems, an installed base is probably resistant to change, described by Hanseth (2002):

"The fact that infrastructures are open and evolve over a long time has important implications for how this evolution unfolds, and what kind of strategies that may be adopted in order to manage or control it. When an infrastructure is changed or improved, each new feature added to it, or each new version of a component replacing an existing one, has to fit with the infrastructure as it is at that moment. This means that the existing infrastructure, the installed base, heavily limits and influences how the new can be designed, and in fact, how it can evolve." (Hanseth 2002, p.7)

Dealing with the installed base

Hanseth (2002) states that, typically, the complexity of the installed base makes coordination efforts and the switching cost huge in more drastic change efforts, meaning that it is hard or impossible to develop competing technologies to what is already embedded into the installed base. For instance, IP v.4, which is a standard for allocating addresses for entities connected to the Internet, is currently causing trouble because there is a constant growing need for more addresses at the same time as the standard itself has clear restrictions regarding how many addresses which can be defined. A new standard developed, IP v.6, can counter the problem. However, due to the interconnectedness of different technologies and standards of the existing installed base, a change from IP v.4 to IP v.6 is seen upon as a huge and extremely difficult task (Hanseth, 2002).

Generally, two strategies for change are presented by Hanseth (2002); **revolutionary** and **evolutionary** approach. The interconnectivity of elements in the installed base do so that the revolutionary approach is seen as highly risky, which can only work on a small scale if the allies are powerful. Hence, an evolutionary approach is seen as more safe. Typically this means changing a small part at the time, then making sure the newly added parts work properly. Then new small parts may be changed. The fact that all steps are meant to be small may be problematic, as the amount of change, and then probably also change in a wanted direction, may be smaller. This again means that advantages of switching from the old to the newer are seen as less, and then less support is induced.

A strategy for gradual change is to use **gateways** to connect the old and new. This may ensure that the old installed base is not changed drastically, but an addition supporting new requirements is implemented. Gateways may also serve as connectors between otherwise incompatible parts. In these ways the gateways become important parts of the installed base if the new is set into use embedded into social practice.

2.5 Summary

In this chapter I have presented the theoretical aspects which this thesis will build upon.

Health Information Systems

The empirical focus in this thesis is on routine health information systems. Typically they function as means to collect, process and present data used for analysis and health management.

The Primary Health Care (PHC) approach was suggested at the WHO Alma Ata conference in 1978. It emphasizes and proposes that essential health care is delivered as close as possible to the people in the community. Later, it has been argued for that decentralization of health services based on the PHC model also calls for a need to decentralise health management. Local decision making should be supported by a district based action-led HIS focusing on routine health information.

Understanding information systems

This section aimed at developing an appropriate comprehension of how to look upon ISs in relation to social structures which influence and are influenced by them. It was argued for that ISs should not be seen as discrete-entities independent of the context surrounding them, but rather as integrated parts of the social system in which they will function. Structuration theory assists in understanding social practice of social systems, but as well how ISs relate to social practice and change in social practice.

Information systems and development processes

Acknowledging the structurational social systems view gives consequences for what can be seen as appropriate design and development strategies for ISs. The strategies have to be context-sensitive, meaning that social practice of the users should be taken into consideration in design and development processes. This is not only for making better systems, but also to reduce resistance for new systems. Participatory design and prototyping explicitly deal with user involvement in these processes. The Scandinavian approach to participatory design does in addition have the particularity of openly trying to change the target context of the IS. Cultivation as a concept underlines the limits of steered human control of a process taking place in the complex setting of a social system.

Information systems and development context

There are several aspects to have in mind when developing and implementing ISs stemming from the context where within the system is developed, and to be implemented. Typically, third world country's contexts face a set of particularly complex challenges regarding ISs development and implementation, probably leading to higher risk of failure for the project or IS. Heeks et al., (1999) suggest looking at gaps between the current social systems practice and the imposed practice embedded

into the IS as probable causes of these failures. The existence of gaps is much in line with how Tromp and Hoffman (2003) define legacy systems; as systems which have been installed in a different environment than the current IT strategy suggests. A typical challenge for change efforts is that it is in general quite difficult to introduce big changes at a time. The conception of installed base takes this into consideration, as a common strategy for change is taking an evolutionary approach where only small bits of the installed base are changed at a time.

3 METHODOLOGY

In this chapter methodology used in my research will be described. Initially an outline of theory for research methods applied will be given. Subsequently, I will describe my own research with a summary of methods used for data collection. Finally I will discuss potential methodological and contextual limitations.

Sections:

3.1 Research methods

I will now elaborate my research approach by first giving a theoretical introduction to the methodology I applied in my research; Action research. However, the action research was conducted in my *case study*, which will be commented upon as well.

3.1.1 Action research

Action research is an established research method applied in various genres of science. In its early days action research was conducted mostly within the fields of social and medical sciences. The method has been in use since the middle of the twentieth century, with the first projects applying action research as a method taking place during the Second World War. Greenwood and Levin (1998) define action research as:

"…social research carried out by a team encompassing a professional action researcher and members of an organization or community seeking to improve their situation. Action Research promotes broad participation in the research process and supports action leading to a more just or satisfying situation for the stakeholders."

Action research is considered to produce relevant results, as it is grounded in practical action with the objective to solve immediate challenges and at the same time generate knowledge; both for the specific context and in general.

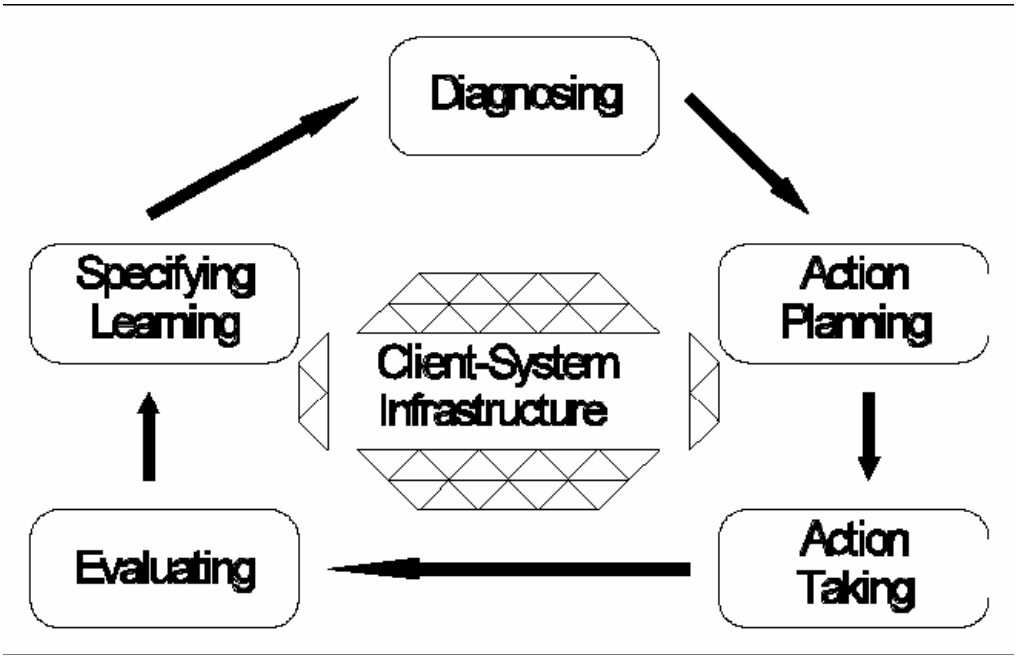


Figure 3: The five stages of action research (Baskerville, 1996).

According to Baskerville (1996), as illustrated above, action research is commonly structured as:

"…a five phase, cyclical process … In practice such methods often vary depending on the application. This ideal approach first requires the establishment of a client-system infrastructure or research environment. Then, five identifiable phases are iterated: (1) diagnosing, (2) action planning, (3) action taking, (4) evaluating and (5) specifying learning."

Further Baskerville (1996) states that:

"A key aspect of the infrastructure is the collaborative nature of the undertaking. The research scientists work closely with practitioners located within the client system. These individuals provide the subject system knowledge and insight necessary to understand the anomalies being studied."

Action research is then a cyclic process that enables iteration, accordingly making action research an explanatory approach allowing adjustment of the research as one goes along (Smith, 1993). This means that, in contrast to more standardized research methods; where typically a theory is investigated, data collected and then analyzed, or a hypothesis is made, tested and evaluated, action research enables a more flexible approach where collection and analysis of data may decide the next step for action (Dick, 1993). Emphasize on change and action implies responsiveness as an important element (Dick, 1993).

3.1.2 Action research in the field of IS

Only lately, towards the end of the 1990s, action research in the field of IS has started to make an impact (Meyers and Avison, 2002). Following the International Federation for Information Processing in 1998 Avison et al. (1999) pointed to five main contributions of action research in development of information systems:

- The multi-view contingent systems development framework
- The soft systems methodology
- The Tavistock School's socio-technical design
- Scandinavian research efforts intended to empower trade unions
- The Effective Technical and Human Implementation of Computer-based Systems (ETHICS) participative and ethical approach to information systems development

Sustainable networks of action

The compound reality to be taken into consideration when acknowledging a social systems perspective in IS represents a common challenge in action research projects. These complexities are generally highly noticeable in action research IS projects in developing countries. A widespread destiny originating from complexities in the context is failure of making action research projects **sustainable**. Typically, action fails to persist after the departure of the researchers. Small donor funded pilot projects focusing on action in a limited scale often face this problem (Braa et al., 2003). Output from limitedly scaled action research initiatives is for practical intentions more or less useless for health management, since only full coverage will help the manager in daily decision making processes. When no benefit of such pilot projects is found, the efforts are being left largely unsustainable (ibid.).

Braa et al. (2003) argue that action research in IS requires large networks to survive, exemplified by HISs in developing countries. Such networks of action are considered crucial regarding scalability and sustainability. This could be accomplished and facilitated by building around ICT (Castells 1996). They draw from Elden and Chisholm's (1993) key lessons from two decades of action research within IS development; the need to situate action within networks rather than on singular units;

"*Using networks of different organisations or work units that can struggle together to learn from each other to develop designs that meet specific requirements of local conditions has emerged as an alternative to establishing experimental units*" (Elden and Chisholm 1993 p.293)

Action research projects therefore need to *scale up* and hence obtain a critical mass. In the context of HISs in developing countries, coverage and sustainability are interconnected (Braa et al., 2003). To be able to scale, action research efforts need to go through alignment processes with existing structures and networks, especially regarding aspects of control and institutionalization. Transfer of appropriate knowledge must be embedded in the alignment processes, because local expert

groups will be responsible for continuing maintenance and development when the researchers have left.

3.1.3 Case study

Benbasat, Goldstein and Mead, (2002, p.81) describe a case study as follows:

"A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or few entities (People, groups, or organizations)".

Another typical aspect of case studies is annotated by Cornford and Smithson (1996 p.49):

"A case study is an in-depth exploration of one situation."

Exploration of case studies commonly need to span over a certain period of time, as a snapshot of a situation has problems of capturing change processes. As a rule, using a multiple of means, the researchers dedicate themselves to a specific situation; the case, and in return a richness of data might be obtained (ibid., p.49). For the purpose of generalization a single case study may not, accordingly to the tradition of positivist science, give appropriate data. However, finding other similar studies for comparison may improve the chance to make the problem area better addressable.

Walsham (1993, 2001) indicates case studies as "interpretive", where different researchers may have diverse perceptions of the problem area. However, the idea is to expose "a truth" rather than "the truth". As something that is interpretive is of subjective matter, a case study of interpretive nature may be interpreted differently by different people, as the case will be narrated using the researcher's own thoughts and ideas on the phenomena described.

3.2 Research approach

My research was conducted as a member of the Mozambican HISP team. The Mozambican HISP is an ongoing action research project within the health sector of Mozambique, and also a part of the global HISP network. At my first stay, I was there together with students participating in the IMSP in collaboration with the UiO, UEM and HISP. Furthermore, the team consisted of Mozambican Ph.D. students and professors from the UiO and UEM. During the second and last stay I mainly worked with Mozambican HISP team members. However, we also got much useful input from the HISP and DHIS expert Calle Hedberg, based in South Africa.

As HISP Mozambique is an action research project, it is defined as a research group, however with strong focus on being an action team working on the cultivation of a district based HIS and improvement of information culture among health workers in general.

As the HISP approach with the DHIS software is officially approved to become a part of the HIS in Mozambique, MISAU has been participating in the planning of action regarding HISP work. At HISP pilot sites, much contribution has been given as well.

In this section I will first describe the action research cycle(s) of my research during my period of studies. I will then shortly describe location and duration of my studies. Further the methods used for data collection, and also potential methodological and contextual limitations in my research, will be discussed.

3.2.1 The action research cycle

As I was a part of the Mozambican HISP team during my stay in Mozambique, and that it existed both before my arrival and after my departure, my involvement had to align to the action and research which was taking place when I was there. My initial plan was to more or less directly go to one of the HISP pilot sites and stay there for the whole trip. However, due to complications between HISP and MISAU the plan had to be abandoned to not create further conflicts. The figure below summarizes the action research with my involvement.

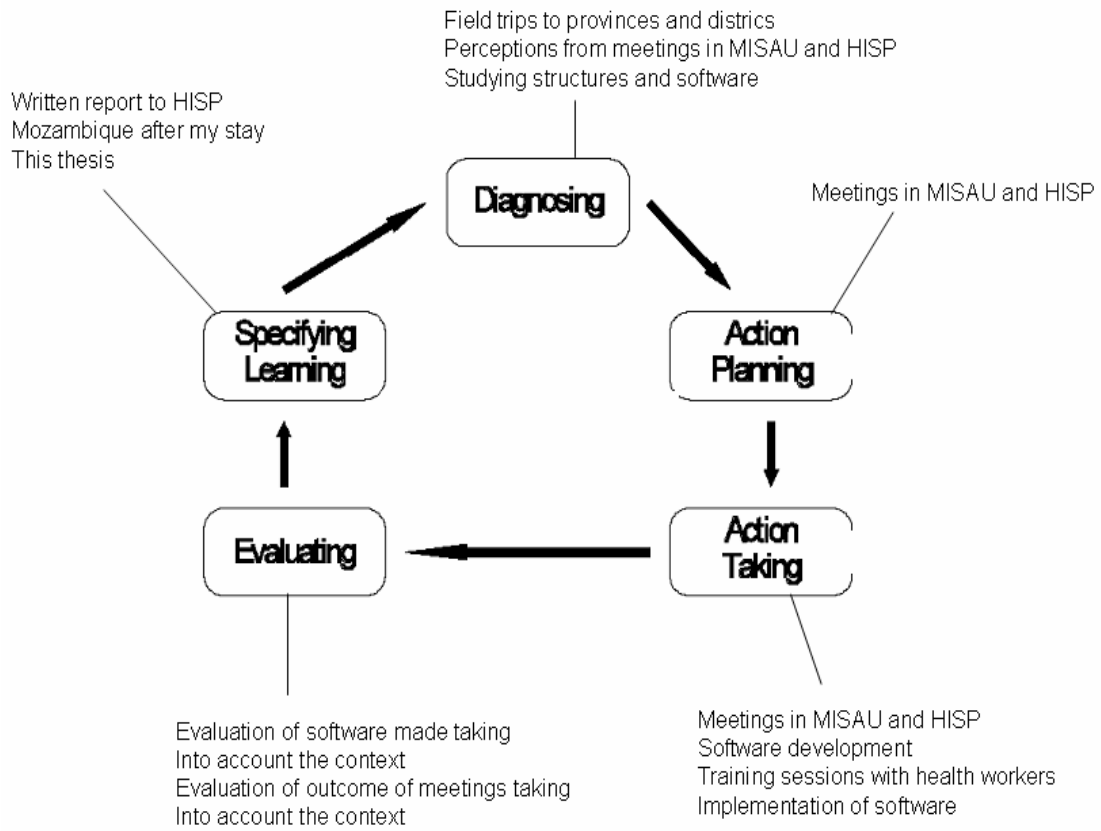


Figure 4: My action research cycle

The figure explains the main "cycle" regarding my research. However, as one may see, for each stage it is possible to find many of the same processes. This is because there are various aspects to take into consideration in IS development and

understanding processes of development for the whole organization. The complexity in ISs relation to the social system and vice versa (see [2]) makes the compound cycle more understandable. Several "cycles" of action and learning took place inside the main frame in parallel. For instance, the software development consisted of several iterative processes within the HISP team; in communication with the ministry; and finally when testing and installing the new system in the context with health management. However, at the same time as software development issues were on the agenda, negotiation processes and learning also took place.

3.2.2 Location and Duration of studies

I will now describe the location and duration of my studies. I choose to divide the studies into the following main phases:

1. Pre-study, Oslo and Lisbon, April 2003, January – 3rd of March 2004
2. Field work and studies, Mozambique, 3rd of March – 3rd of June, 5th of July – 1st of September 2004
3. Further support on software development and finding additional sources, 1st of September – June 2005
4. Further support and final trip to Mozambique, October - December, 2006

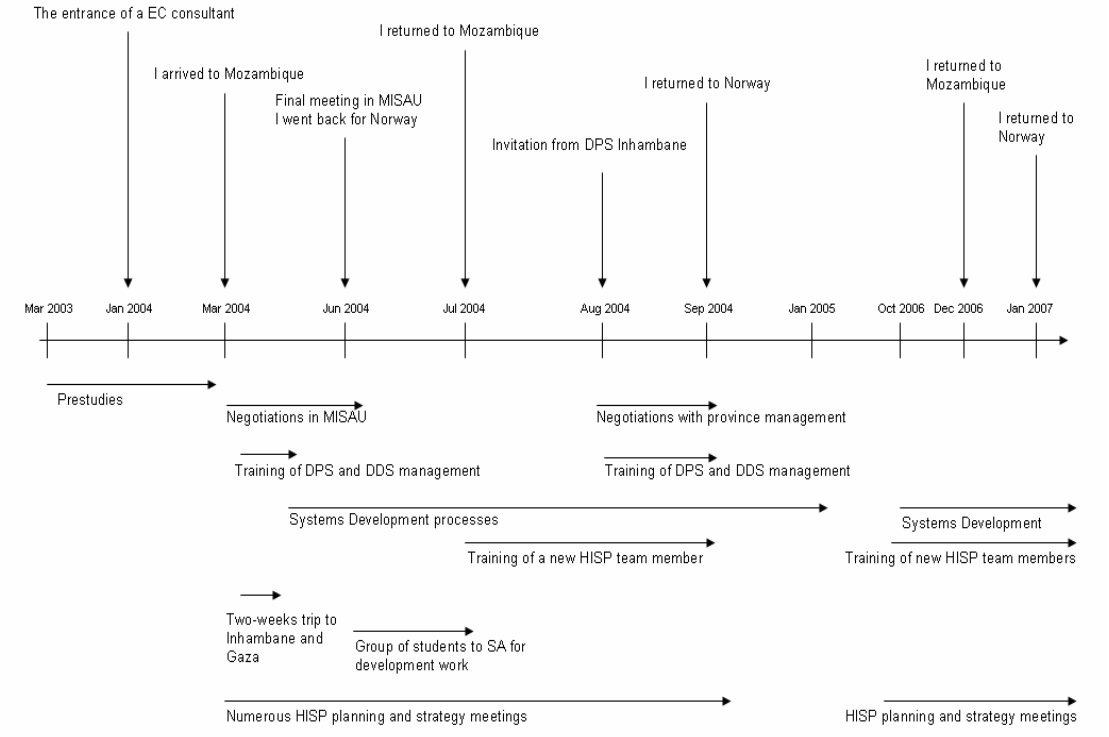


Figure 5: Chronological presentation of processes and events

Pre-study

It was of course hard to know what I would meet when arriving to Mozambique. To prepare for my stay, I tried foremost to obtain knowledge about HISP and the DHIS software package. Preparation started when I followed the course "Health Information Systems" at UiO during the spring semester 2003. There I got my first experiences with HISP and the DHIS software. The course was lead by three Ph.D. students from Mozambique. Knowing them facilitated my understanding of the context at later stages. Endless conversations prior to my stay in Mozambique, during my stay, and also after, have helped me much in getting a better insight about HISP and HISs in Mozambique, social structures and the society of Mozambique in general.

Before I went from Norway, I had several conversations with some master students that had been working with a HISP project on Cuba. They helped me refresh my memory regarding the DHIS software, as well as giving me good advices for my work, and what I should be prepared to meet in Mozambique.

Having in mind that my plan for Mozambique was to work mainly in the province and district offices, I stopped a month in Lisbon in Portugal doing a language course, as the official language in Mozambique is Portuguese. Without any knowledge of the language spoken, it would probably have given too many constraints in my planned work to do it in an appropriate way. I experienced when staying in Mozambique that knowing some Portuguese gave me several advantages. In MISAU I could communicate with people without knowledge of English, hence getting otherwise unavailable information. I could read and understand documents produced by MISAU, usually written in Portuguese. When staying in the provinces for research, holding courses, conducting training and interviews, it was essential for me having some knowledge of Portuguese. During my stay in December 2006, all communication in the development team was in Portuguese.

Field work and studies

I arrived to Mozambique the 4th of March 2004. In the following months I participated in several different activities regarding my research and HISP work. Through the whole first stay I followed the IMSP. It mainly consisted of lectures and discussions about HISs.

However, the first field trip, between 14th and 28th of March 2004, was arranged in connection with the IMSP. All the students together with the available Mozambican Ph.D. students and a professor from UiO went to two of the HISP pilot provinces (province of Inhambane and Gaza) to study the organization of health care in the Mozambican context. During the field trip I visited several institutions of all types in the Mozambican health care/management hierarchy; DPSs, DDSs, hospitals and health facilities.

The second trip to the province was between 17th and 29th of August 2004. The Mozambican HISP team had been invited by the DPS of Inhambane to hold a course about DHIS and information use for province- and district management staffs. In

addition we saw it as a nice opportunity to finalize some localization modules for the DHIS application and in addition discuss strategies for implementation with the DPS staffs.

The research and action consisted of the following:

- Explorations and interviews at all levels regarding HISs and work routines to gain higher understanding of the context
- Planning and execution of systems development with health management and within the HISP team
- Training of health management

During the period from end of March to early June, and beginning of July to middle of August 2004 I was situated in Maputo.

The research and action consisted of the following:

- Negotiation of planning and strategies within MISAU
- Negotiation of planning and strategies within HISP
- Exploration of HISs and Systems development
- Interviews of, and conversations with, central stakeholders in MISAU and HISP
- Obtaining and reading various minutes, strategy plans etc produced by MISAU and HISP Mozambique
- Tutoring of a new Mozambican HISP team member

Further support and finding sources after returning to Norway

After my return to Norway, I still supported the development of the customized applications we had started on while staying in Mozambique. However, I still felt a need to gather more data for my research, and by collecting data from various papers in the HIS domain in general, and about HISP in particular improved my understanding of the problem area. Further interviews and conversation also enhanced my level of knowledge.

So, the research and action consisted of the following:

- Systems development
- Interviews by e-mail of MISAU people
- Interviews and conversations with HISP people
- Reading of appropriate literature

Field trip to Mozambique, December 2006 and preparations

Meanwhile my time as a student went on in Oslo, the HISP project's HIS tool underwent big structural changes. As will be described in a later section (see [6.2.2]), this lead to the need for rewriting of localized modules, among other things. I was

kindly asked to support the needed work, and hence went for a four week trip to accomplish this. However, already before I went I started on some parts of the systems development issues.

The research and action consisted of the following:

- Planning of strategy and action
- Exploration of HISs and Systems development
- Training of new Mozambican HISP team members
- Interviews of central HISP stakeholders

As a summary the specific locations visited together with number of persons and types of interventions with health staff will now be indicated.

Locations Visited		In contact with persons	Type of intervention
Province of Inhambane	Inhambane DPS	6	Interviews, informal conversations, observation, training, planning and negotiation
	Vilanculos Hospital	4	Interviews, observation, and informal conversations
	Vilanculos DDS	2	Interviews and observation
	Massinga health centre	2	Interviews and observation
	Massinga HISP course	25	Interviews, informal conversations, training, planning, observation
Province of Gaza	Gaza DPS	4	Interviews, informal conversations, training, planning, observation
	Milene DDS	7	Interviews and observation
	Chowke DDS	6	Interviews and observation
	Guija DDS	2	Interviews, training and observation
Maputo Province	Maputo Province DPS	6	Interviews and observation
MISAU	Planning directorate	11	Interviews, formal and informal conversations, observation, planning and negotiation

Observation in the table above have the meaning unplanned observation; or observation "in action", se section below. Taking into account more planned observation, for instance of work routines, it is more difficult to give estimations, as many people were observed, and maybe the same persons at several occasions.

3.2.3 Data collection methods

My selection of methods was conditioned by the type of research I did, and the research setting. According to O'Brian (1998) action research is a holistic approach where various tools for data collection should be appropriate. Investigating numerous aspects of the context opened up for applying several different means for data collection. Taken into consideration the flexibility (Dick, 1993) and richness (Smith, 1991) of data that qualitative research methods may give, it was a natural choice for me to go that route.

The methods used to gather information will now be described.

Interviews and discussions

During the time of investigation for my research work I conducted numerous interviews. The format of the interviews has varied a lot; from fairly structured, to more conversation-like. The different types of interview techniques have several reasons. Caused by the dynamics of the field, new needs for information might appear as observations or interviews are done. This means that more or less ad hoc interviews could be required, and the questions would become thereafter. However, the flexibility of interviews and conversations makes it possible to obtain much information "on the fly" as responses may lead to additional data and produce new requests. Some interviews were also done as e-mail correspondence. When I had returned to Norway and needed additional information from stakeholders in MISAU I used this form of communication. Throughout my stays in Mozambique, in between and after, I had endless conversations and discussions with other HISP team members, not only from the Mozambican setting. This has given me valuable data for this thesis. Generally I did not encounter any special problems regarding getting people to be interviewed except in some occasions when an interview meant direct disruption of daily routines for health workers at more peripheral levels. One time we had to do an interview with a nurse while she was attending patients.

Observation

Action research is typically an approach where researchers abandon their conventional roles as observers of events (Cornford and Smithson, 1996). However, this does not mean that observation as a means of getting relevant information should be forsaken. To obtain a picture as rich as possible, a diversified bundle of methods, observation included, may be appropriate. For me, doing observations was an important source of information. The observations can be divided into two main categories; planned and unplanned. Regarding unplanned observations, when

participating in meetings, doing development work, training, etc. responses from others actually became a crucial source for information for my research, even though initially unintentional. I found it important always to be aware of what happened around me when working. This helped me a lot in understanding how people react to input and output and how people understand things differently. Observing how people react when they are asked about critical issues could give good clues about how their attitudes are for these issues. An example of the importance of observing other peoples reactions could be from when we were holding a course about HISP and DHIS for health management in Inhambane and its districts. It became clear that missing response sometimes was due to the situation rather than lack of knowledge. All the directors from the province were at the course, and many lower level management staffs were afraid of speaking in plenum. They rather sat still instead of taking the risk of saying something that could be perceived as "stupid" by the province managers. However, while talking with them one and one they revealed more knowledge.

However, at several instances I "stepped" into, or looked at, the context or a situation with clearer goals. Being an observer in the natural surroundings and watching common routine work gave many indications on how the day of health workers and management was structured. Other things than routines could for instance be looking for graphs and diagrams on walls, or other physical signs of how information was being handled and processed.

Literature and schemes

I never encountered any problems in obtaining any report schemes or forms from the health statistics system. At all levels in the hierarchy people were willingly providing any information wanted if they had what I requested. In MISAU I was met with an open mind from everybody if I asked. Several important documents regarding evolvement of the health sector in general, and as well about cooperation and planning with HISP, were provided. Many research papers and technical annexes have been written about HIS and HISP development in Mozambique and other countries. These have been essential for me regarding understanding processes in the Mozambican context in particular and other locales in general, also from before I was staying in Mozambique myself.

Field notes

According to (Hammersley and Atkinson, 1983), *"it is difficult to overemphasize the importance of meticulous note taking"*. Especially from important meetings in MISAU about decisions and planning for the development I found it highly important to take detailed notes. There were in general many disagreements, and to be sure to remember exactly what had been said, note taking started already "in action". Important, and what also could seem unimportant at the time being, was written down. During interviews and observation notes were taken at a regularly basis. This also counts for other field work settings. During the software development, two types of notes were taken; planning of what was still remaining with priority lists, and

detailed descriptions of problem definitions and possible solutions for the problems that had to be solved.

Training

Important in action research is the objective of improving conditions where research is conducted (Greenwood and Levin, 1998). Among HISP processes training of health management is seen imperative to make improvements in information culture. In addition, transfer of knowledge to local experts is seen as crucial for obtaining sustainability of action (Braa et al., 2003). I participated in/conducted several training sessions. For health management, they consisted of ad hoc training sessions of staff in province and district offices when travelling around, and a planned two days course for all province and district health management in Inhambane in August 2004. I tutored several new Mozambican HISP team members so they could manage to do appropriate work for the team. The applications we made for the Mozambican version of DHIS were developed in Microsoft Visual Basic. As I had no experience with this programming language from before I had to tutor myself. It went by a "learning by doing development at the same time" kind of principle, if it exists.

Exploring information systems

When staying at health facilities, hospitals, district and province offices I got a chance to see the information system in use. At facility and district level the system(s) was mostly paper based. At province level I saw the computer based systems in use, input, processing and output; the inscribed work routines and how they were actually used. From MISAU I also got hold of the three main computer systems that were relevant for my work; Sisprog, SIMP and the so-called Modulo Basico. The developers of SIMP work(ed) in MISAU, and guidance I got from them regarding their system, and as well some special issues concerning other systems was crucial when own doing systems development tasks.

HISP team cooperation

Although much of the data for this thesis comes from my own experiences a member of the Mozambican HISP team, much information has been collected through the sources and resources of other Mozambican HISP team members. This is due to the fact that HISP has existed in Mozambique since 1999, and to be able to follow and understand the whole process, I must as well relay upon other sources than my own field studies.

3.2.4 Potential methodological and contextual limitations

Role as a researcher

The intention when I went to Mozambique was to rather soon go to one of the provinces to support implementation of the HISP approach there. However, as it turned out I could never do as planned, and for that reason my actions and research became somehow a bit more arbitrary. The original plan was abandoned, and may have resulted too scarce data on areas of specific interest.

I had never done work as a "researcher" before I arrived to Mozambique, so initially I had very limited knowledge of how it might be conducted. This probably hindered me from searching for and finding relevant issues in the beginning. However, the learning curve was steep, meaning that adaptation to the context as a researcher soon improved. As a researcher in the qualitative and interpretative field, I can objectively not know if my methods for data collection were the most appropriate ones. Though, I still believe they were sufficient as I mean the problem areas in this thesis have been shed light on in an appropriate manner.

Role as a researcher in the research context

Arriving as a researcher and in addition from another country, may have given restrictions to what information was shared with me from the interview subjects. Especially, this seemed to be the case when interrupting the staff from their daily routines, and at the same time asking critical questions about their quality of work. In a couple of occasions I was met with some scepticism, and some took a defensive position, probably obstructing a good conversation. It is in general not possible to know if the interview subjects were telling what they really meant or giving the whole truth. Maybe I was told what they assumed I wanted to hear. An example: Almost all health management staffs who were asked about their use of DHIS during our two weeks field trip in March 2004 said that they really wanted to use it. However, the software was installed at more or less every location. Still no one had taken it into use. It may seem strange that everybody is so eager to use something they have access to, but no one is actually using it.

As the HIS development project in Mozambique has evolved, there is no doubt (for me) that many of the involved people are not completely objective to what is happening. Everybody seems biased regarding what has happened and is happening, and why, in one way or the other. Since I was not heavily involved with the project before my arrival, I soon noticed this. I therefore tried to maintain my objectiveness during my stay and work. If I succeeded, is up to someone else to evaluate. However, because of this early observation, it has been in my mind all the time when reading papers produced from findings in the context of investigation as well. Another aspect is how the human mind works. During conversations and interviews I got hold of a lot of historical information. However, people have a tendency to remember what is important for them and their interests, meaning that biased memory recalls might have materialized (Shermer, 2002).

In connection with the previous subsection I will comment shortly about the use of second hand sources of information. I have drawn on knowledge and understanding from other research papers and resumes as source of data. This means that what I read is already interpreted at least once. My re-interpretation then might loose some of it weight as all reflections behind the first interpretation (done by others) may be unknown to me. In addition, when doing comparison of different contexts, there may be a miss-match between outcome and cause between the contexts. Example: Mavimbe (2005) found several causes behind inflated immunization coverage rates in the Province of Niassa, Mozambique. In Inhambane and Gaza I found similar values. However, without investigating the specific reasons for those numbers in the respective provinces, I can not know if the outcome (which has similar character) has the same reasons. Nevertheless, already found causes may be used as something to look for, and in addition the methods used to investigate for causes may be replicated.

Language challenges

In Mozambique, especially on the countryside, English language is in general not known. This means that several conversations and interviews had to be in Portuguese. Even in the ministry of health I had various conversations and did interviews in Portuguese. Though, my Portuguese was improving all the time, and eventually reached an acceptable level, there was room for misinterpretations both ways. Regarding reading documents in Portuguese I don't see language problems as a source for errors, as I always made sure to read thoroughly enough, or I got assistance, to make sure I understood everything the way it was meant.

3.3 Summary

My research was informed and conducted by taking an Action Research approach. Action research is seen upon a rather democratic method where researchers do their actions and research in the context studied at the same time as aiming at improving problematic conditions. It includes three elements: 1) Research. In my case this was about how to better understand legacy systems challenges. 2) Participation. Mutual learning between researchers and problem owners for understanding and enhanced possibilities for better solutions. I worked with Mozambican health staff and management and stakeholders at several levels in the Mozambican health sector. 3) Action. In my case we tried to develop better HIS solutions for the Mozambican health sector than was already there.

Action research is not a quantitative method, and was so for a long time seen as inappropriate in the IS field. However, lately it has gained broader acceptance. A typical challenge for action research projects is to maintain the action after the researchers leave. In developing countries action research projects are often donor funded, and having a limited scale and time span of efforts. Regarding sustainability of action, scale of the project seems to be of crucial factor. Small scale action research initiatives are much less likely to be sustainable than larger networks of action.

Interpretative studies give room for misinterpretations. Regarding my specific study, the scope of it might have had an impact of the outcome of the study. Relatively few systems and only parts of the Mozambican health care organization are investigated. However, by following processes over more time, it might still be possible to generalize findings. Furthermore, Greenwood and Levin (1996) state that as general laws must apply to particular cases, particular cases test the validity of general laws.

PART 2 EMPIRICAL STUDY

Figure 6: Busy day in the field, DPS Gaza

4 BACKGROUND

In this chapter I will provide some background information about the Health Information Systems Programme (HISP) in general and an introduction to the Mozambican HISP project. In addition the HIS tool of HISP; the DHIS software will be presented. The last section of this chapter will give a brief introduction to Mozambique.

Sections:

4.1 HISP

The Health Information Systems Programme (HISP) was initiated in South Africa in 1994. Its objective was to develop a HIS suitable for meeting the challenges of post-apartheid South Africa. As a part of the programme the DHIS tool was developed. It was explicitly developed to support local health management. After achieving national rollout in South Africa, the HISP approach with its accompanying HIS tool, has been exported to many other countries, including Mozambique, Cuba, Ethiopia, India, Malawi, Vietnam and Mongolia.

I will describe the context in which HISP was originally developed and present the development process. Then, the HISP philosophy and usual methods are described. A summary of the global HISP network will then be presented. I will also give a description of the DHIS software with some of its important features.

4.1.1 Development context

After fall of apartheid in South Africa, the African National Congress (ANC) government created the Reconstruction and Development Program. The program targeted communities disregarded by the former apartheid regime. An important part of the programme was the development of a new national health information system. The existing system was based on the apartheid ideas and politics, with different health programs for Europeans, Coloureds, Asians and Blacks. 60 % of the resources were used by the private sector, serving only 20 % of the population (Braa & Hedberg, 2002). The overall goal for the redevelopment of the health sector was equity in health. The Alma Ata WHO-model for health systems was highly influential in the redevelopment program, which had a focus on decentralisation of the health system. In the period HISP took shape, there was a strong national focus on reform, in health as well as in other sectors. The success of HISP, which integrated major changes in approach for the HIS, has to be seen in combination with the high motivation for reform in the political sphere in the health sector at that time.

4.1.2 Initiation of HISP

HISP was one of several HIS projects initiated as a part of the development of a new health system. HISP was based at two Cape Town Universities, receiving funding from the Norwegian Agency for Development Cooperation (NORAD) for a two to three year pilot project. University staff, activists from the health sector and NGOs, and two Norwegian researchers made up the HISP team. HISP's HIS software, the DHIS, was developed, as implied by its name, with the intention of supporting the new district-based administrative structures, as proposed by the Strategic Management Team on Health Information Systems in Western Cape (Braa & Hedberg, 2002). The project's first pilot phase was carried out in three pilot districts in Cape Town from 1996-98. The pilot phase was concentrated around two major research and development areas:

1. The development of essential data sets and standards for PHC data
2. The development of a District Health Information Software (DHIS) to support implementation and use of such data sets

In 1999, after a successful pilot phase, the Department of Health in South Africa adopted the strategies, processes, and software developed in the pilot districts for a national standard. DHIS is free, open source software. Its free availability and the Norwegian research interest, lead to the export of the software and HISP ideas to other developing countries. In 1998 the first HISP project outside South Africa was initiated; in Mozambique. The approach has later also been adopted by Malawi, Tanzania, India, Mongolia, Ethiopia, and Vietnam, with various results so far. In Cuba, a HISP project existed between 2001 and 2003, but was eventually shut down.

4.1.3 The HISP approach

The initial goal of HISP was cultivation of a health statistics system to enable the restructuring of the health sector aligned to the policies of the ANC government. As well, the HISP approach to health system reforms and HISs are well aligned with the WHO declarations and strategies for reaching the global health for all goals, including the Primary Health Care model (WHO, 1978). Equity in health care, local empowerment and local use of information have been and are still seen as key aspects for the South African Ministry of Public Health and HISP. The DHIS software was developed with the following objectives (Braa & Hedberg, 2002 p.14):

- Shift of control of information systems from central towards local levels, i.e. towards more equal control between central and local levels
- Local flexibility and user orientation; it should be easy to adapt the software to local conditions
- Support for health sector reform towards decentralisation and the development of health districts, i.e. integrating vertical flows at district level
- Empowerment of local management, health workers and communities
- Horizontal flow of information and knowledge, based on the principle of free access to all anonymous, aggregated health data/information

The DHIS software enables local use and analysis of local data, and adapts statistical systems to the local setting, to enable local learning and management. Braa and Hedberg's (2002) hierarchy of standards, as illustrated in Figure 7, is inscribed into the DHIS software. The idea is that the top level defines a standard data set, procedures and indicators, which each level below can make a standard extension to. In this way, for instance, a health district is given the liberty to implement a locally adapted variant of the provincial HIS, which again is an adapted variant of the national HIS.

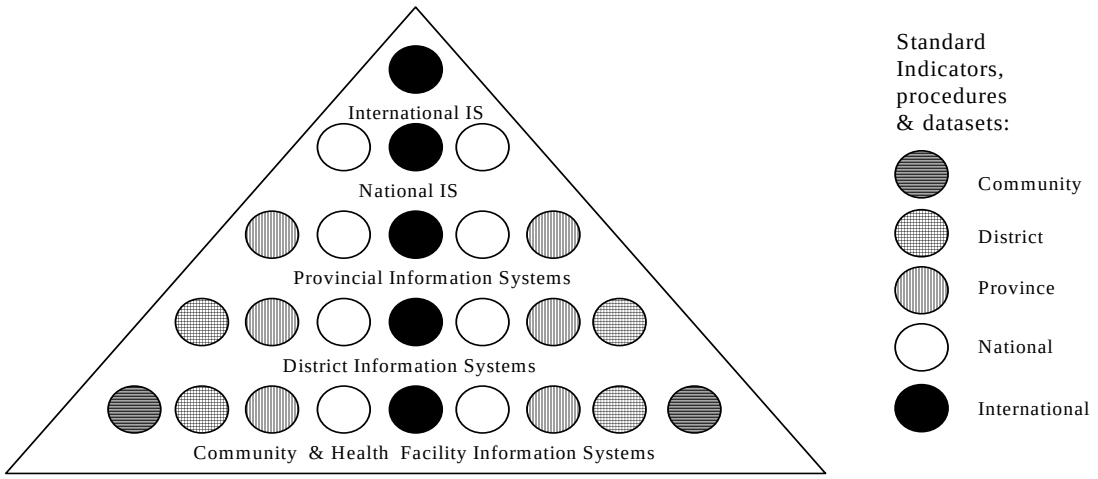


Figure 7: The hierarchy of standards. Each level can expand the standard of the level above (Braa and Hedberg, 2002)

Systems development and research methods utilized by HISP are influenced by Scandinavian Systems development traditions (see [2.3.1]). Action research (see [3.1.1]) has been the principal research method within HISP. Systems development methods are typically heavily based on participation, evolutionary prototyping and cultivation. The development of the first standard data set in the Western Cape Province in 1997 was a complex process, with a multitude of actors, at different hierarchical levels and with different views and educational backgrounds, including health sector employees, university staff, activists from NGOs and researchers (Braa and Hedberg, 2002). A close collaboration between those using the DHIS and the developers resulted in rapid cycles for prototyping and improvement, sometimes creating new versions on a daily basis in initial phases (ibid.).

Also in the process of transferring the software to other countries and the adaptation processes that involve development of local data structures and datasets outside South Africa, HISP focuses strongly on participation. HISP considers itself as an opposing network to capitalist driven development, being a way for poor countries to gain from the large network of medical, technical and informational expertise, the free software, and the important ideas of local empowerment and action led data collection.

4.1.4 HISP internationally

The HISP approach, with its accompanying HIS tool; the DHIS, has been exported to several other countries. However, results have been varying.

Translating the HISP approach to other countries

Main HISP activities in South Africa and other countries constitute the composed HISP approach, including the DHIS software package, systems development methods, and health management practices. They all reflect the HISP approach adapted to the country in which it is applied. The HISP approach emphasizes importance of context sensitivity. This means that the HISP models and methods cannot be directly replicated when HISP processes are initiated in other countries. Aspects as power structures and politics, transport and communication infrastructure, human resources, health system and information culture are seen as central elements making up typical challenges in HISP implementation. These elements may vary in different countries.

Braa, Monteiro, and Sahay (2003) state that, despite differences, transfer of the HISP approach between countries is viable for two reasons: First, the international standards on health services and procedures create basic similarities between the structure of the health system, the tasks and targets of the health services, and the basic principles of data reporting and health information systems. Second, The HISP IS development strategy is general of nature, in the sense that, given the conditions of the first point, it aims at the achievable within a given context, and has tools and technical approaches which allow rapid prototyping, feedback and interaction with users at multiple levels.

Nodes in the HISP network

The HISP approach has over several years been tried adopted or prototyped in many countries. Though, South Africa and Norway are still seen as the central hubs of the network. Typical methods for the HISP network, as described above, have been central parts of processes. Current country nodes as of today are seen in the figure below. I will below give a short introduction to the Mozambican HISP project.

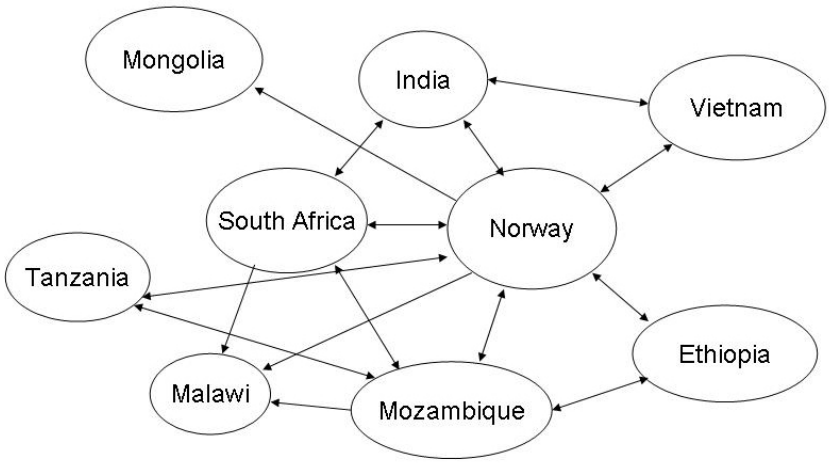


Figure 8: Global HISP nodes

HISP Mozambique

The relative success of HISP in South Africa resulted in trying to spread the HISP approach with its accompanying HIS tool (DHIS). In 1998 Mozambique was the first country to be engaged with HISP processes outside South Africa. An agreement for the project was created among UEM, MISAU, UiO and the University of Western Cape, South Africa. A Ph.D. program (6 Mozambican Ph.D. students) and eventually the IMSP were started. The programs had intentions of strengthening education in general, and doing research under the HISP umbrella in particular. The aim was that the Ph.D. students should be the driving force of the HISP implementation in Mozambique. In 1999 a preliminary study about ICT use in the Mozambique and the Mozambican health sector was carried out (Braa et al., 2001). In 2000 MISAU approved to start pilot implementation of the HISP approach in three health districts. Further descriptions of the Mozambican HISP project will be presented later in the empirical study, were action is categorized into appropriate themes.

4.1.5 The HISP database tool; DHIS

The DHIS is developed and provided by HISP. The software is a flexible statistical database tool which allows the tailoring of content and analysis. The first version of software was developed in 1997 by the HISP team in South Africa, and since then it has been improved and released in many new versions. The software has several properties that make it suitable for adapting to a new context:

- Support for fast and easy set up of a prototype database structure that can be used quickly, especially in prototyping processes
- Through its flexibility, it supports evolutionary prototyping by gradually changing and incrementing design
- The software is multilingual, using a separate multilingual module for fast translation to any language
- The software is free for use and modification anywhere

Even though the uncommented source code is free to be modified, it is highly platform dependent. DHIS is written in Visual Basic (VB), and only runs in a Microsoft environment with Windows, Excel and Access. However, in the Mozambican health context Microsoft Windows and Office are available “everywhere” due to that most computers are donated with the software bundled. In addition, “free copies” are not uncommon. To make installable versions of the source code of DHIS, Install Shield is used, which one has to pay for.

The DHIS software has gone through constant development since the first release in 1997, with a continuous emphasize on real user needs. As the HISP approach and the DHIS software have been spread around, a continuously more diverse user group has to be taken into consideration in the software design. Currently there are two new versions of the DHIS in development. One of them, the DHIS v1.4, is still using and supporting the same technologies as the original DHIS, but the database has gone through a total reconstruction because it was growing too big and being too slow. New functionality has also been added. For instance, a requirement for the

Mozambican health system was about major changes in some parts of the system's user interface. However, even high level politics and common global tendencies have had major impact on the evolvement of the DHIS application. For instance, a requirement from the Indian state of Kerala was that use of proprietary software solutions in organizations ran by the state should be avoided. The old DHIS versions were only possible to run in a MS Windows environment. Yet another version, the DHIS v.2.0, is currently being developed in a Java framework environment. It is platform and database independent, and web enabled. Core functionality, which has been learned to be important for different HIS contexts, is continued from previous versions of the DHIS. In Mozambique, the versions of the software which affected my work were the 1.3 and 1.4.

System architecture and features of DHIS v.1.3 and 1.4

Architecture

Figure 3 illustrates the software's architecture with a front-end and back-end separation. The software is a stand-alone database application meaning that the database definitions and populated data are stored on the local machine. The front-end file holds all general functionality including user-interfaces, database manipulation logic and export functionality. The back-end file stores all data and data definitions of the statistics system as well as tailored analytical functionality. The Access MD (the name of the front-end module) front-end module serves as both a database design and maintenance interface to the administrator users and as the main application for data entry for the end users. Putting data entry, data analysis and administrator interfaces in the same module, was done intentionally to easily enable users to adapt the application to their needs.

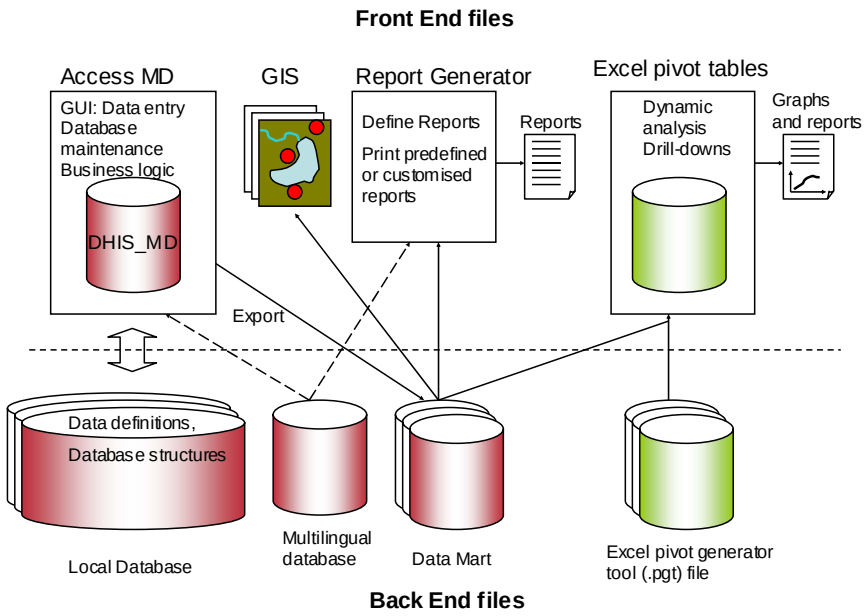


Figure 9: DHIS architecture. Explanation: The back-end front-end separation of DHIS (Sæbø & Titlestad, 2003)

System features

I will in short describe important DHIS features. The first list will be a description of the DHIS v.1.3 which was the one in use and development when I was in Mozambique in 2004. I will then describe important new features with the DHIS v.1.4 which was the one in development when I was in Mozambique in December 2006.

DHIS v.1.3 features:

- User-defined and flexible organizational hierarchy construction, however with a fixed number of hierarchical levels set to 5.
- Only data entry at lowest level
- User-defined and flexible data element, indicator, data validation, report generator definitions (add, edit, delete)
- User-defined and flexible analysis possibilities after import to MS Excel Pivot tables
- Support for export to ESRI Arc-Explorer, a GIS-software that providing geographical data analysis.
- Support for monthly routine data, semi-permanent data and survey data input
- Data entry user interface representing all data in list format (important for this study)
- Easy access to source code for modifications by developers
- Problems with handling non-English standards for decimal separation characters in database
- Multi-lingual enabled

Additional DHIS 1.4 features:

- Redesigned database structure for improved performance
- New conceptions like data element group, data set, data set group, indicator group and organisation unit group
- Support for more period types (daily, weekly, monthly, quarterly etc.)
- Customizable data entry user interface

4.1.6 Summary

The context where within HISP was initiated was in a period of substantial political reform, and with a strong focus on health sector reform and adoption of the PHC approach of WHO. From its commencement in the time of post apartheid in South Africa, HISP has spread to several other countries. Mozambique was the first country outside South Africa with any HISP processes going on. Although the point of departure for HISP in different countries have varied a lot, Mozambique included, similarities, such as international standards on health care services and procedures makes it probable that the approach may be appropriate for other contexts as well. In addition, design and development approaches for ISs in seen, by HISP, as applicable for various settings due to the strategy of aiming at the simple having tools which makes interaction with users and rapid prototyping easier.

The HIS tool of HISP, the DHIS software was developed with widespread use of participatory design and prototyping. Aiming at being relatively flexible it is meant to be able to support a variety of different needs for different users. However, as HISP and the DHIS software have been spread around various new requirements for the software have emerged, which has lead to several upgrades and already two full redevelopments. The technical features of the system which are relevant to this thesis were described

4.2 Mozambique Country Profile

The Republic of Mozambique is situated in the east southern part of Africa, sharing boarders with South Africa and Swaziland in the south, following with Zimbabwe, Zambia, and Malawi in the west and to Tanzania in the north. The official language is Portuguese, but according to the national census of 1997 only around 40% of the population knows it. This gives a clue of the general educational level of the population, as in schools Portuguese language is the only used. In total 40 languages are spoken in Mozambique. According to the census, about 20-30% of the population is Christian, 15-20% is Muslim, and most of the remainder adheres to traditional beliefs.

Mozambique was in the beginning of the 1990s considered as one of the absolute poorest countries in the world, still recovering from two severe wars (war for independence and civil war) of devastating outcome for the country's population and infrastructures during the last 30 years. In the last 10-13 years the economic growth has been one of the strongest in the world. However, indicators considered important for the general living standards of the population (e.g. infant mortality) are still among the absolute worst, and not following the trend in economic growth.

The capital, Maputo, is located in the very south of the country, close to Swaziland and South Africa. The climate of the country is tropical in the north to sub tropical in the south. Mozambique is divided into 11 provinces containing all together 129 districts.

4.2.1 Historical summary

To better understand the Mozambican context of today I find it important to summarize some aspects of the history of the country and in addition look at some characteristics of today's society and infrastructure.

History of Mozambique shows as a typical trend exploitation of the Mozambican people and land. In 1891 the administration of "Mozambique" was shifted to be run by a large private company, controlled and financed mostly by the British. Development supporting the interests of white settlers and the Portuguese homeland was prioritized, often supported by forced African labour. Little attention was paid to Mozambique's national integration, economic infrastructure, or education of the native population.

Consequences of the coup by António de Oliveira Salazar in Portugal 1926 reinforced the tendencies from the already embedded standards: A highly centralised bureaucratic political and administrative leadership. This lead to the continuance of maintaining the Portuguese interests, while the native population was still disfavoured.

After World War II prices on commodity boomed. This resulted in an even more harsh exploitation of native labour. A massive immigration of Portuguese people caused even more expropriation of lands.

Independence

The continued harsh exploitation and exclusion of the native population led to the dawn of organized resistance. FRELIMO[4] was formed, and in 1964 it initiated an armed campaign against the Portuguese colonial rule. After 10 years of sporadic warfare and because of the return to democracy in Portugal the colonial rule redraw, and administration of Mozambique was given back to its native people and FRELIMO. In June 1975 Mozambique became independent.

Rapid exodus of the Portuguese population left Mozambique behind with scarce human resources. After receiving independence the country was left with fewer than five engineers and only 80 medical doctors (Wikipedia, 2007).

Fighting with limited resources, FRELIMO decided to move into an alignment with the Soviet Union, the German Democratic Republic and Cuba. A one-party Socialist state with strong central government was established. In the wake of the new quasi-communist rule nationalisation of land and real estate, ridiculing of traditional and religious leaders and customs all contributed to narrow down the political base of FRELIMO.

[4] "Frente de Libertação de Moçambique"; The Mozambican Liberation Front

Civil war

The new government offered bases for guerrillas of the Zimbabwe African National Union which was opposing to the white minority rule in Rhodesia (now Zimbabwe). This led to hostile reactions by the minority regime; among other things support for a Mozambican rebel movement; Resistência Nacional de Moçambique (RENAMO). RENAMO was rapidly characterized by its extreme brutality. FRELIMOs approach against the apartheid regime in South Africa then became more cautious. However, after the fall of Rhodesia, South Africa rapidly stepped up the military support for RENAMO. So, in 1982, RENAMO, sponsored by the apartheid government in South Africa and USA, launched a series of attacks on transport routes, schools and health centres. Mozambique descended into civil war.

In 1990, with the apartheid crumbling in South Africa support for RENAMO dried up. Negotiations were initiated between FRELIMO and RENAMO and a new constitution with Mozambique as a multi-party democracy was adopted. In 1992 a final peace agreement was signed.

It is estimated that approximately one million Mozambicans lives were lost during the civil war. 1.7 million took refuge in neighbouring countries, while 4 millions were internally displaced.

4.2.2 Politics and Economy

Mozambique held its first democratic election in 1994. The maintained political relative stability during the last 13 years has given the country the opportunity to receive substantial aid from other countries and foreign aid organizations.

Although economic growth has been excellent after the civil war a typical challenge has been that capital has a tendency to stay in the hands of investors and the rich not giving any positive implications for the common Mozambican (Ardeni, 2000).

After civil war dependency on foreign aid in Mozambique increased as the government found itself incapable of handling emergency and reconstruction efforts. By 1996, half of Mozambique's expenditures were financed by donor aid (van Diesen, "Aid to Mozambique"). However, as more international organizations and NGOs appeared on the scene, and small, uncoordinated projects bloomed in every sector, fragmentation of projects hindered the possibility of building overarching sectorial policies (Ibid)

As with other donor dependent countries, Mozambique faces a loss of sovereignty as donor resources may dictate policy. In the mid-1990s, Mozambique's donor aid began to shift from emergency relief to longer-term reconstruction and development aid, presenting the government with an opportunity to take a more significant leadership role in its country's development (UNDP, 2000)

In the years 2000 and 2001 major setbacks were experienced due to weather disasters. Main areas of the southern part of the country were flooded and two big cyclones hit the country, with devastating results. Some agriculture production areas had drops up

to 50% in the province of Gaza. There was extensive damage to physical infrastructure. As well in 2001 there were floods with serious consequences for the south – mid part of the country.

4.2.3 Education

Under colonial regime, educational opportunities for native Mozambicans were very limited, and the illiterate rate of the population was as high as 93%. After independence the government gave high priority to improvement of education. However, during civil war relapse was encountered as schools were some of the targets for the military actions of RENAMO. After the war high focus was again set on rebuilding the school network.

In recent years the school construction and teacher training enrolment have not kept up with population growth. Post war enrolment was high, though the quality of education has suffered. As well, the school attendance is still relatively low compared to other countries natural to compare with. The problems of low quality and poor effectiveness of the school system indicates that the majority of the students do not accomplish functional literacy despite them having attended schools (Wikipedia, 2007).

4.2.4 Infrastructural challenges

I will here sum up some challenges related to infrastructure which may have implications for the development of the country in general and for the health sector in particular.

Road Infrastructure

In general, road infrastructure is of poor condition at most areas of the country. From the colonial times interests of the colonial settlers reflect the historic development of infrastructure. Infrastructure was built between trade partner countries (typically Mozambique – South Africa and Rhodesia (now Zimbabwe)), but in the inner and northern parts of the country little was invested.

Mozambique has suffered heavily from its wars regarding lines of communication. Much infrastructure has been damaged or destroyed. With the floods in 2000 and 2001 substantial damage was done to the southern and mid parts of the country. When visiting at a heath facility in the Gaza province we were told and shown how the water had stood 3 meters high. All the nearby area had been evacuated and damaged.

Figure 10: On the way to Guija the rainfall had done something to the road…

Electricity

Having in mind trying to computerize the HIS in Mozambique access to electricity has to be taken into consideration. In major cities availability to electricity is the norm. However, in villages and rural areas nothing can be taken for granted. District and facility level in the health sector are typically situated in those areas, having many locales without access of electricity at all. Where present, it is often extremely unstable which makes working with computers a big challenge. While we interviewed a staff member at the DPS in Gaza she had to restart the computer 6 times due to unstable electricity.

4.2.5 Health care situation

Several former health sector workers were important stakeholders among the leadership of FRELIMO after independence. Emphasize on the public heath sector was deemed as important. A consequence of a National immunization program initiated in 1976 and succeeded in 1982 by the WHO EPI (MISAU, 1987), was that strong focus was set on the preventive part of the heath system. Immunization, latrine construction and general heath education was seen as central aspects (Roemer, 1992).

The number of heath facilities and their functionality were greatly expanded. However, during the civil war much was destroyed. Even though the construction of heath facilities continued, many were lost due to war actions. At the time of independence there were 426 heath facilities in the country. In 1986 this had

increased to 1326, but at the same time 595 had been destroyed or looted (Roemer, 1992). However, with a more stabilized country due to peace and free elections, construction has gone up again. As of 2006 more than 1500 health facilities served the country's population.

Mozambique struggles with a diverse assembly of communicable diseases, several of which are in endemic form. The pattern of diseases is grounded in the existing socio-economic profile of the population and climatic conditions. The country is vulnerable to outbreaks of water-borne diseases as cholera and dysentery. Currently the most serious diseases affecting the population are malaria, tuberculosis, acute respiratory infections, diarrhoeas and sexually transmittable diseases as HIV/AIDS. The country is much affected by HIV/AIDS with a prevalence rate of around 14% of the population between 15-49 years of age (WHO, 2005). It is projected that life expectancy in at birth 2007 is 39,8 years (Theodora, 2007)

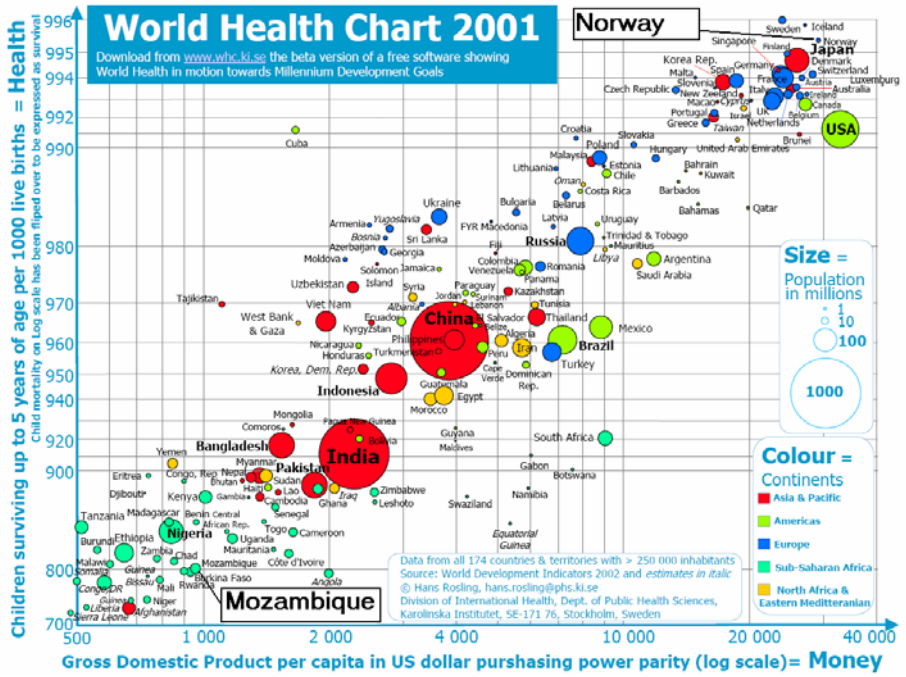


Figure 11: World Health Chart, 2001

The World Health Chart (WHO and Karolinska Institute in Sweden), illustrates the relationship between GDP and child mortality rate. Mozambique is found in the very most lover part of the scale on both axes together with most other sub-Saharan African countries, indicating both low income and health.

Mozambique is a poor country in possession of limited resources to spend on healthcare. In addition, large parts of the health care budget are made up of foreign aid. Total health expenditure is 4.3 % of the GDP, which translates to 30USD pr. citizen (WHO MZ, 2003). This is above the 10 USD which WHO proclaims as necessary to deliver a basic primary health care, however still in the lower part of the scale.

An important part of coping with epidemics is education of the population as well as supply of preventive services. This is a problem if the public heath efforts are not

reaching the entire population. Signs indicate that this is the situation in Mozambique. For instance, only around 27% of all deliveries are done within the public health services, and only 30% of deliveries have skilled attendance (WHO MZ). In Mozambique, inadequate infrastructure, lack of resources and education among population and health staff are important factors in this connection (Mavimbe, 2005).

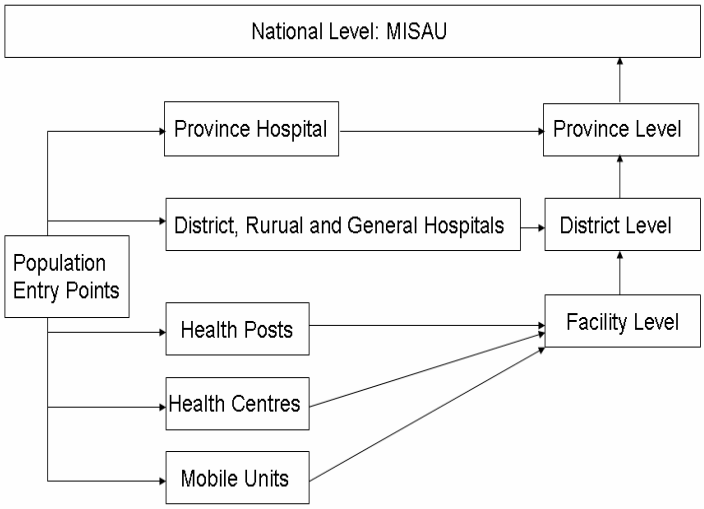
4.2.6 Summary

The people and general infrastructures of Mozambique have historically been disadvantaged by diverse factors. After being colonized for long periods and reaching independence in 1975, civil war for many years gave severe consequences. Today the country faces challenges of being poor and dependent of foreign aid. In addition, low level of education among citizens and relatively poor health care services makes general development difficult.

5 THE MOZAMBICAN HEALTH SYSTEM: SITUATIONAL ANALYSIS

In this chapter I will describe parts of the Mozambican health system which influenced the research of this thesis. I will bring in knowledge obtained from research conducted by others when it is important for a fuller understanding of the area. The administration of health care is first described. Then the HIS and challenges will be commented. Towards the end I will provide a short summary of official plans and objectives regarding the health care organization.

5.1 Organization of Healthcare and Administration



The national heath system in Mozambique is involving many actors, from international agents and donor community, to MISAU with its diversity, and further down in the hierarchy to province, district and sub-district at community level. The national heath system is responsible to provide heath care for the people. There are three main levels of management; national (MISAU), provincial and district, but where only national and province level have own budgets. A simple picture of the structure is shown in the figure above. Patients mostly enter the network at the most peripheral points, typically health posts and health centres. If necessary, they are then transferred to more technically developed units, like hospitals. Due to low quality service given at many of the heath facilities, many choose to go directly to a unit known for better service (Romer, 1992.). Each health unit has in the HIS a code indicating such as level and number of staffs, number of beds and technical equipment.

The 11 province level units are hierarchically situated directly below the MISAU administration. They are each a centre for administration and management (Braa et al., 2001), and the administration of different health programs is mostly conducted from province headquarters (Braa, 2002).

Each province is divided into districts, at a total of 129 for the whole country. The districts have typically an administration unit with responsibility for data collection, analysis and transmission of reports and data to higher levels. The districts have responsibility for rural/general/district hospitals (typically zero or one in a district) as well as health posts/centres (typically between 5 and 20). They are all classified accordingly to available services and resources.

Information about the actual number of health facilities in the districts showed to be less known at province level. I experienced this when I was staying in Inhambane in August, 2004 updating the DHIS database. At the DPS in Inhambane they actually had two different, inconsistent lists of health facilities for the province. When I asked which of them was in use as a reference, I got to know that they were using both because they did not know exactly what the real situation was. While having a course for all the DDS staffs in the province, August, 2004 we used the opportunity to get everything corrected.

5.2 Health Information Systems

I will in this section describe important issues regarding the technical parts of the existing HIS in Mozambique as of today. Towards the end typical challenges regarding how the systems are handling organizational changes which have occurred during the years, and how this have been dealt with by the organization itself, will be outlined. The systems in focus will be the ones which had direct impact for the HISP work while I was participating with work.

5.2.1 The National health information system; SIS

SIS[5], the National Health Information System of Mozambique, consists of both paper and computer based systems. For some parts there is no computerization of the system at all, while for other parts computerization of health data is done at province level. National and provincial levels are the only ones fully computerized as of today, 2007. In general, where computers exist at district level, they are not used much for HISs related matters (Braa et al., 2001), which we also observed. A reason for this is that the SIS had until 2005 only supported HIS software for province and national levels. However, recently, the Modulo Basico (see [0]) has been taken into use at some pilot districts. In addition, there are several donor funded health projects with computerized statistical systems functioning at district level (see [5.2.2]).

The current health information system (SIS) dates back to 1982. In 1989 a revision was done due to constraints related to lack of defined objectives, complexity of forms, duplication of data, and data collected which were found to have no function (MISAU, 1992). As a result of the revision the system was simplified and a "minimum" data set was made to avoid duplication. The number of data collection forms was reduced from 60 to 12. In addition several indicators were added on numerous paper system forms (Braa, 2001). The purpose of this was to facilitate the use of information also at lower levels. For the paper based HIS two main manuals exist. One is a collection of all forms in the paper based system, where a thorough explanation of how to enter data correctly, how to calculate indicators etc. for every form is given (MISAU, 1994b). The other is about use of information for management. Again, a thorough description of all health indicators in the health system is made to facilitate the understanding of the data and so getting information out of it (MISAU, 1991).

[5] Sistema de Informação para Saúde

Flow of health data; an example

Routine health data is typically collected at the population entry level (see figure 12), in paper forms. These are so aggregated in different ways at the DDS, and then sent to the province for computerization, or then again sent to MISAU. Without going into too many details, below is a simple illustration of how the data from health programs currently taken care of by Sisprog (see next section) and SIMP (see next section) flows through the hierarchy. I show these because these health programs were the ones we were mainly concentrating on in our systems development efforts. In addition, Sisprog was the first computerized HIS in Mozambique, and SIMP is one of the major ones at present time:

- PAV – Vaccination/immunization data (reflected in the paper forms A01, A02 (daily collection at facility level), A03 (from facility to district level; monthly aggregates) and A04 (from district to province level; monthly district aggregates)
- SMI - Mother and child health/consultancy data (reflected in the paper forms B01, B02, B03, B05 (collection at facility level), B04 (from facility to district level; monthly aggregates), B06, B07 and B08 (from district to province level; monthly aggregates)

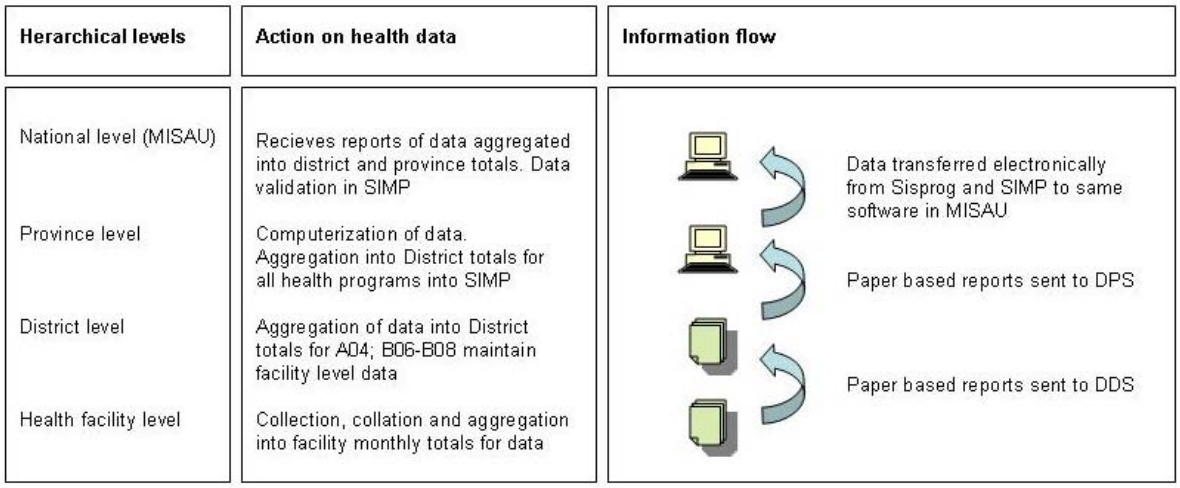


Figure 12: Information flow of PAV and SMI data

5.2.2 Computerized HISs

In this section I will give a description of three computer HISs in use in the HIS in Mozambique today which influenced what we were doing in the adaptation process of the DHIS. In the stage of the adaptation that we were in during my stays in Mozambique, we worked with replacing the two HIS applications Sisprog and SIMP. Throughout my first two stays the focus was on replacement of Sisprog. However, during my last, the possibility to replace both Sisprog and SIMP was investigated and processed. The "Modulo Basico" stemming from the HISA approach is described as

it developed into more or less a direct "competitor" to the DHIS and HISP approach. This background for this will be elaborated in [8.2]

Some typical characteristics of the systems will be described, and in addition I will relate them to their function in the organization and how functionality is influencing the organization.

Sisprog

Sisprog is an application for entering routine data and analyzing it, made for the planning department in MISAU between 1992 and 1994. It was the first computerized HIS for the Mozambican health sector. Because of the situation with lack of important infrastructure (as electricity) and low level of skills among district and lower levels staff, the application was designed to be used at only national and provincial levels in the HIS hierarchy (Sisprog, MISAU, 1994). Due to the very limited experience with computers among potential users when introduced, the overall goal of the design was to make it as simple and easy to use as possible, disturbing the routines of the health workers as little as possible (ibid.). It takes data from the SIS paper forms B06, B07, B08 and A04 (see appendix G)[6]. I will now describe some typical system functionality of Sisprog

Flexibility and integration issues

In terms of flexibility Sisprog has its clear restrictions. It is impossible to remove, add or change order of data elements or indicators. In general, very few indicators exist in the system, and they are all health program specific. Only what was seen needed from the ministry at the time the application was developed is embedded. However, it is possible to include new organization units in the application. This has to be done in the national version of the application and then distributed to the provinces.

Compatibility issues

Sisprog embodies several compatibility problems. In the version used in the province offices, there are hardware compatibility problems. It only functions on computers with Intel Pentium 2 processors or older, which means that the whole HIS is dependent on old, functional computers. This problem will be even more difficult to handle as time passes by, however hard already. It is only a matter of time before one or more will stop working. Province health management expressed their concerns regarding this:

> *"It is unfortunate that Sisprog does not work on new computers because if the old one that we have breaks down, we will have no functioning health information system." (DPS director, 2004)*

Though, not all versions of the application have this restriction. After some investigation in MISAU, I was able to find a version that functioned on my laptop computer with an Intel Pentium 3 processor inside. This was the national version of the software, however incomplete for use in the provinces. However, it was well suited for my research and familiarization with the software.

[6] Actually, at earlier stages data from other health programs were included as well.

Data validation possibilities
Sisprog has no data quality check functionality.

User friendliness
On the other hand Sisprog has an advantage of being quite user friendly, and as it has now been used for more than ten years and current staffs know it well.

An example of user friendliness is how the application follows the structure of the paper forms in the system. This means, for instance, when one wants to enter the data for the form B07 (see appendix G), one chooses the option "enter data for B07". A new window then opens, and it looks much like what one sees on the paper. Another aspect regarding user friendliness is that it is easy to navigate around in the application, as there is information on every page how to browse around to pages available from that page. It is all operated with the keyboard, and is extremely quick to use.

Technical support
The source code of the application is in practice lost. It is on a laptop which has stopped working, and hence its data are unavailable. In addition, the developers are gone a long time ago. According to Nhampossa (2005), the implementation of Sisprog was seen upon as a one-time event, and after that no technical support for the system has been given.

Sisprog properties and organizational change

Due to the lost source code, no technical support, and that Sisprog has no built in functionality for changing content, a potential problem arises if data collected in the HIS needs to be changed. Official change requirements have taken place several times during the years of existence for Sisprog. Sisprog reflects the central stakeholders understanding of the HIS's needs the year it was made; 1992. Later it has been seen necessary to collect other data, and in addition, changing old definitions. As an example I will use the immunization program, which has gone through alterations since Sisprog was introduced. The health program (represented as A04 in paper system) was in 2002 extensively changed. As Figure 13 shows, in the old form the data elements in the columns 2^{nd}, 3^{rd}, 4^{th} and 5^{th} dose were combined into only one column (2^{nd} to 5^{th} dose). Before entering into the paper health staff has to calculate the "2^{nd} to 5^{th}" data element by sum the 4 previous ones.

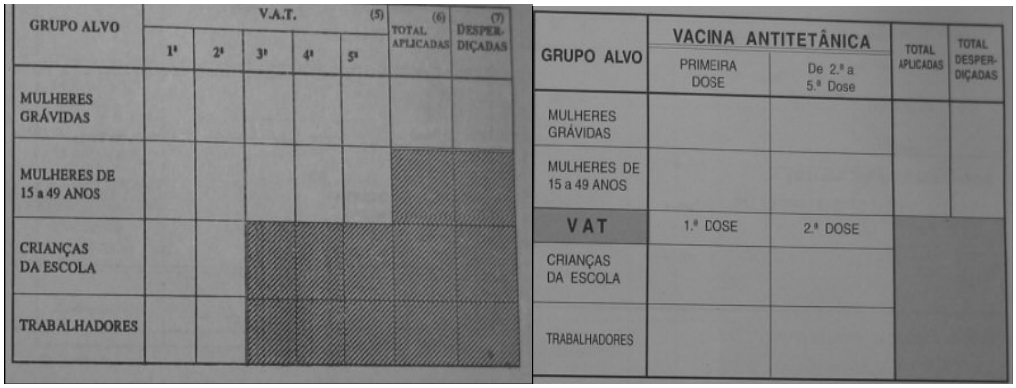


Figure 13: Figure 1: Left: old structure; Right: new structure (Picture: Nhampossa, 2005)

A problem then occurs when the data shall be introduced into Sisprog. Since it is impossible to do alterations in Sisprog, the new data element "VAT 2nd to 5th dose" can never exist. Sisprog will continue to look like the old form, see Figure 14 below.

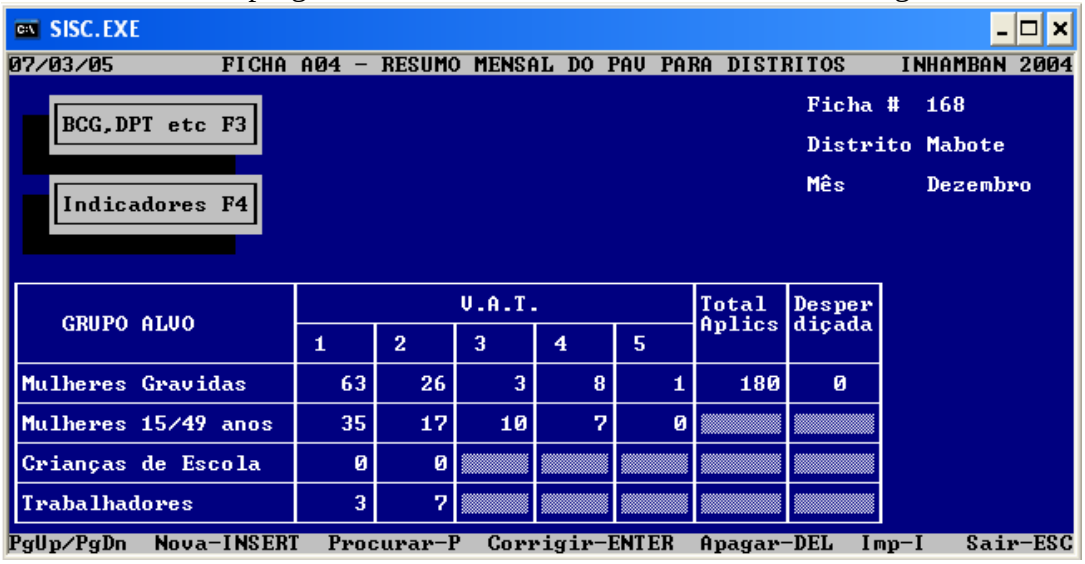
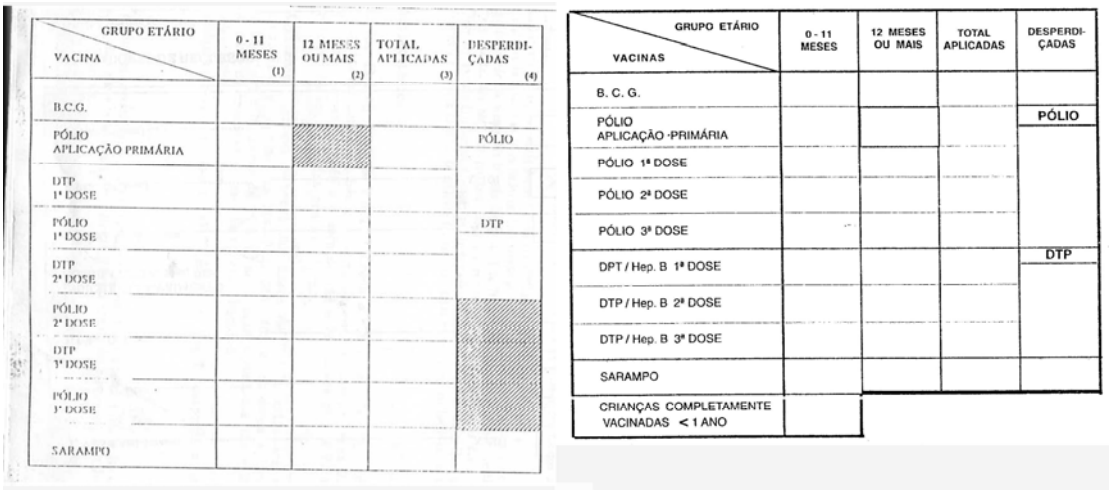


Figure 14: The unchangeable Sisprog input format

The solution for this has been to use the data element VAT, 2nd dose as the new data element. According to Skobba (2003) there was no official flagging day for when to change this procedure, giving possibilities for the same data element having different content without any easy way to find out. The use of the old 3rd, 4th and 5th dose data elements in Sisprog has also been used as the new data element, giving little consistency in the databases (Skobba, 2003).

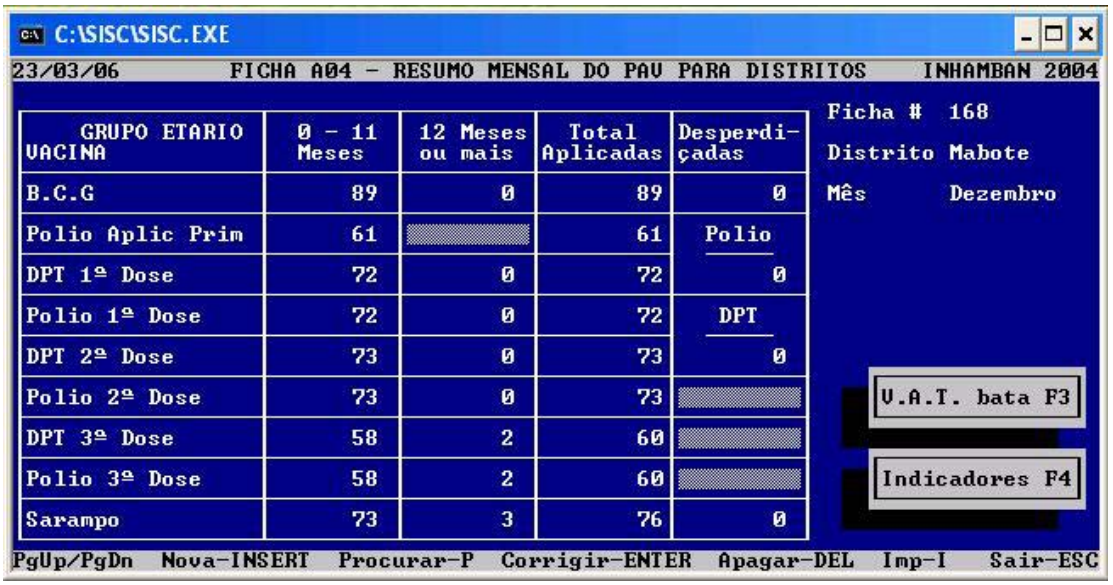
In addition to this, new data elements have been added into the HIS (for instance the data element "Total number of fully vaccinated children under 1 year of age" (see A04)), which is not possible to reflect in Sisprog. Also, the order of the data elements in the paper forms of A04 was changed in 2002, for making comparison between data elements more easy for health workers, see Figure 15:



GRUPO ETÁRIO / VACINA	0 - 11 MESES (1)	12 MESES OU MAIS (2)	TOTAL APLICADAS (3)	DESPERDIÇADAS (4)
B.C.G.				
PÓLIO APLICAÇÃO PRIMÁRIA				PÓLIO
DTP 1ª DOSE				
PÓLIO 1ª DOSE				DTP
DTP 2ª DOSE				
PÓLIO 2ª DOSE				
DTP 3ª DOSE				
PÓLIO 3ª DOSE				
SARAMPO				

GRUPO ETÁRIO / VACINAS	0 - 11 MESES	12 MESES OU MAIS	TOTAL APLICADAS	DESPERDIÇADAS
B. C. G.				
PÓLIO APLICAÇÃO -PRIMÁRIA				PÓLIO
PÓLIO 1ª DOSE				
PÓLIO 2ª DOSE				
PÓLIO 3ª DOSE				
DPT / Hep. B 1ª DOSE				DTP
DTP / Hep. B 2ª DOSE				
DTP / Hep. B 3ª DOSE				
SARAMPO				
CRIANÇAS COMPLETAMENTE VACINADAS < 1 ANO				

Figure 15: The old (left) and the new (right) format of the A04 paper form. Notice the different order of the data elements, that old data elements have new definitions, and that a one new is added (Picture: Nhampossa, 2005).



GRUPO ETARIO VACINA	0 - 11 Meses	12 Meses ou mais	Total Aplicadas	Desperdiçadas
B.C.G	89	0	89	0
Polio Aplic Prim	61		61	Polio
DPT 1ª Dose	72	0	72	0
Polio 1ª Dose	72	0	72	DPT
DPT 2ª Dose	73	0	73	0
Polio 2ª Dose	73	0	73	
DPT 3ª Dose	58	2	60	
Polio 3ª Dose	58	2	60	
Sarampo	73	3	76	0

Figure 16: Sisprog can not change the order of the data elements, and presents so the data element order in the original format, even when changed in the paper forms.

However, since these changes are impossible to do in Sisprog (see Figure 16), different order of data elements between paper and computer became a problem. Mavimbe (2005) found, in a comparison survey for the data elements with a new order in the Niassa province of 2003, that approximately 25% of the values for these data elements were misplaced when entered into Sisprog. Staffs were entering data as if they were on the old format. They had not been taught, or were not aware of, that there had been a change in the order. However, this is not necessarily a problem only when computerizing data; it can even be a problem when aggregating and collating at lower levels, as the paper system has changed at all levels until computerization. The problem of so many mistakes when entering the data into Sisprog may also indicate that the staffs don't look much into the data they are handling; if they ever had looked at the data as purposeful, the possibility of seeing that something had changed in the

forms should be somewhat higher. Simple analysis would possibly have shown strange numbers when the data were entered wrongly.

Since it is not possible to export tables or graphs from Sisprog making appropriate reports and data analysis is harder to do. At the time being MISAU is restructuring the paper based system, with many new data elements and lay-outs. For Sisprog, this would have been yet another impossible task to handle. So, Sisprog has become a constraining factor for the organization.

New strategies and integration efforts: SIMP

Among other issues, to try to cope with some of the challenging issues regarding Sisprog, a new system was made (MISAU, 2005); SIMP (Sistema Integrado de Monitorização e Planificação). The developer of SIMP told me that he had made it as a temporarily solution with the intention to improve integration of the fragmented HIS. In addition, new data elements not possible to enter in Sisprog were added for direct introduction into SIMP. It started on the initiative from the developer himself, and was initially piloted in the Zofala province. It was implemented country-wide in 2002.

SIMP is a statistical tool consisting of two different versions (SIMP DPPC and SIMP DPAG). One for health related data (DPPC), and the other for financial data and budgeting (DPAG). There is an interface between these versions, so that important data can flow between them. SIMP is not a database application, but uses MS Excel spreadsheet format. For screenshots, see appendix E.

Here I will list up some properties of the system which affected our actions and research about replacement processes.

Input and output of the system
In SIMP DPPC data from Sisprog and BES (epidemiological data) is imported. It is also possible to enter data directly into SIMP in some places, making up for the inflexibility described about Sisprog. As well it is possible to enter semi-permanent data, e.g. resources available, population data etc. SIMP DPPC has been used as a part of the official HIS since 2002. It produces 12 reports for use in analysis. The reports are in tabular format. There are no possibilities to represent the data and indicators on graphs in the system.

In SIMP DPAG all data are entered directly into the application. It is possible to enter enormous amounts of different financial data. However, we got to know when I was in Mozambique in December, 2006 that only in Inhambane they are using the DPAG version, and only some few parts of it. In the rest of the country it is not in use. This means that at province level, the main information hub in the Mozambican HIS, there is none budgeting/financial data supporting systems in use. SIMP produces 54 reports for use in analysis. The reports are in tabular format. There are no possibilities to represent the data and indicators on graphs in the system.

Flexibility issues
For the user it is impossible to change anything inside SIMP. The input, processing and output are fixed. If new data elements, indicators or other issues are going to be

added, changed or deleted, this must be hard coded by the SIMP support team situated in MISAU.

Technical support
After the elections in 2005 many changes were due. Among other issues, the Mozambican Minister of Health formulated a strategy which emphasized the importance of dealing with challenges "in house". A consequence in MISAU was that many of the foreign consultants did not get new contracts for work. Among these was the developer of SIMP. Fortunately, another employee had been hired as technical staff at an earlier stage, so knowledge about SIMP was not lost. For instance, between the first and last time I stayed in Mozambique, possibility for exporting data between different hierarchical levels on USB memory sticks were added. Earlier only Zip-drives could be used. However, regarding more direct health related matters nothing was changed. In 2004 I interviewed a lady at one of the DPSs, and she said:

> *"The problem with our current system is that it is impossible to enter other data than those defined already in the system. For instance, I would very much like to have the data element "vitamin A for new born" as I know that these data are very relevant to monitor the health of pregnant women" (DPS staff, 2004)*

Two and a half years later, in the end of 2006, the data element "Vitamin A for new born" was still not to be seen in any HIS. In addition, we got to know from health management in December 2006:

> *"We would like to be able to use graphs to facilitate our analysis of the health data. Now, in this system, we have only tables which do not give appropriate room for analysis" (DPS director, 2006)*

It seems like technical support does not manage to fulfil all users' requests.

Data validation
SIMP holds some data validation functionality. Data validation in SIMP consists of comparing newly entered data with data from one year back. If the gap is too big, after user's definition, the user gets feedback about it. Apparently the validation functionality is only applicable in the national version of SIMP, not the provincial. If any discrepancies are found when validating, the procedure of correcting is bothersome: If data, according to their validation, is proved to be questionable, the ministry people have to call the province office to make them correct it, and then the province office staffs have to send all the data again.

User friendliness
At a first glance SIMP appears to be quite messy. The installation is immensely unintuitive, without any good instructions. In the main application many illogical choices have to be made to get through relatively easy functionality. However, there are relatively few possibilities other than importing data and generating reports, so the lack in functionality makes it possible to learn relatively fast. By observing how health management used the application, they seemed comfortable using it.

Aggregation of routine data
All routine health data are aggregated into district totals in the procedure of importing it from Sisprog or BES. Data in Sisprog is in the form as monthly facility data for most programs, but in SIMP this is aggregated further to monthly district data. However, resource data is at health facility level.

This type of aggregation of routine data could be unfortunate, as the possibility to "drill down" in the hierarchy to obtain information from facility level is lost. For instance, if there are differences between the data collected and the norm at a certain time, it will be less possible to find out from where, and then also for which reasons since detailed information is gone. The opposite may also occur; even if no data is reported from a certain facility at a certain time, this could be less visible, as the district aggregate may somehow even out the numbers. However, all resource data are facility aggregates. This means that numerous appropriate indicators for facility level (which means easier resource allocation for district levels) could have been calculated with maintenance of facility aggregated routine data. Performance indicators are examples of these.

The Health Information System Approach

An outcome of the negotiation processes in MISAU was the dawn of a new HIS approach. The computer system of the approach is called "Modulo Basico"[7]. The approach to HISs which the Modulo Basico is built upon has no special name, so I have called it "*The Health Information System Approach (HISA)"* for easier recognition.

The HISA approach has never been a part of the official plans of MISAU. Nevertheless, piloting projects started already in 2005, and I got to know when I stayed in Mozambique in December 2006, that it would probably be introduced country-wide within short time. The system has never gotten any official assessment, and if it can support the official objectives of the organization has never been evaluated in MISAU.

I will describe the approach and system briefly. The information I will present I have collected through conversations with the EC consultant, through MISAU negotiations, and by an analysis of the computer system itself.

Approach
The main idea behind this software/approach is to implement what is there from before on paper, to computers, and introduce data which was earlier entered into other systems now into the Modulo Basico. The emphasis is on ease of use, and use as little time as possible on dealing with health information among health workers and management at lower levels. When a new system is to be introduced, it should change as little as possible for easier acceptance in the context. The developer told that the background for these thoughts was gotten from 12 years of experience with making a HIS for Zimbabwe. No experience had been collected in the Mozambican health context outside MISAU.

[7] Means Basic module in English

The software
I will here describe some critical issues regarding the software accompanying and supporting the approach.

The software is a routine HIS with support for entering routine data, making reports, with export/import functionality. During my first visit in Mozambique, the developer's intention was to integrate all other programs in the Mozambican health context into the Modulo Basico (see APPENDIX D). However, when I returned in December 2006, the intentions seemed moderated, into being a replacement for Sisprog, and in addition offer a system that could be used at the DDSs. Export to the SIMP application is made after MISAU requirements. For screenshots of the Modulo Basico, see APPENDIX D.

Flexibility issues
The idea of the designer of the system is to facilitate what is there already, not necessarily trying to make changes. When it comes to the user's possibilities for doing changes, for instance due to special local needed information, it resembles much the application Sisprog. It is possible for the user to alter or enter new health units. Semi-permanent data values, such as population estimates and facility information can also be changed, and historical data are stored. However, all data elements, indicators, analyses and reports are hard coded. There are very few indicators in the system.

So, if there is a wish for changing the input or output from the system, it must be done by a computer programmer. In a conversation with the consultant, it became clear that this was not seen as a problem for him. As he said, during 12 years of experience in Zimbabwe no one had ever asked for other locally customized reports than those demanded by the health ministry. When he had offered to make some, no response was ever given. A reason given for this was that the general level of skills of health staff was low, so there was no real understanding of what could be needed, and therefore there was no need to support it.

Data validation possibilities
The system has no possibilities for data validation. The consultant said that the health workers had no real interest of possibilities for validating data, as introducing data and making reports was seen as just a job that had to be done, and they wanted to do it as quickly as possible. Thus, the system is supporting this.

User friendliness
After years of experience in the Zimbabwe context the user friendliness of the system became understood as crucial. Simplicity and ease of use was what the health workers wanted, and they got it. However, when a health unit is going to be chosen, in any place of the system, it is not possible to select from any list with names. The user must know an internal code for the respective health unit.

5.2.3 Fragmentation, vertical programs and donor organizations

As mentioned in [4.2.1], Mozambique is experiencing a significant degree of aid dependency from external donors. Within the heath sector this has been a part of the history since the civil war period in the 1980's. It is estimated that 50% of the total periodic expenditure comes from the international community. Additional budgets are often earmarked for specific projects (Paviganani and Durão, 1997; Chilundo 2004).

The role and capacity of MISAU to control external resources has been limited, as actors, like UN agencies and NGOs, often mediated between recipients and donors. MISAU itself is divided into national directories, and internal integration is hard to achieve, magnified by independent donor funding (Batley, 2002). As the Health Minister once stated: *"…The ministry was a ministry of projects rather than a ministry of Health…" (Former Minister of Health, Dr. Songani, 2002; quoted in Batley, 2002)*

The project-based handling of challenges, together with already existing inappropriate software solutions, has given the rise of several program- and project-specific systems in the health sector. As a result, as of today HIS has become fragmented information-wise, consisting of several vertical health programs emphasizing the support for central level needs and the needs of the specific programs/projects (Braa et al., 2001; Chilundo 2004). Some consequences of this have been acknowledged:

- Data is extensively aggregated (Braa et al., 2001).
- There is a large gap between local needs of information and the actual information collected (ibid.).
- Duplication of data and collection of data; Chilundo and Aanestad (2004) identified 3 different health programs for malaria reporting, and 3 regarding HIV/AIDS. Similar data are collected and sent through different vertical corridors with no communication lines between them.

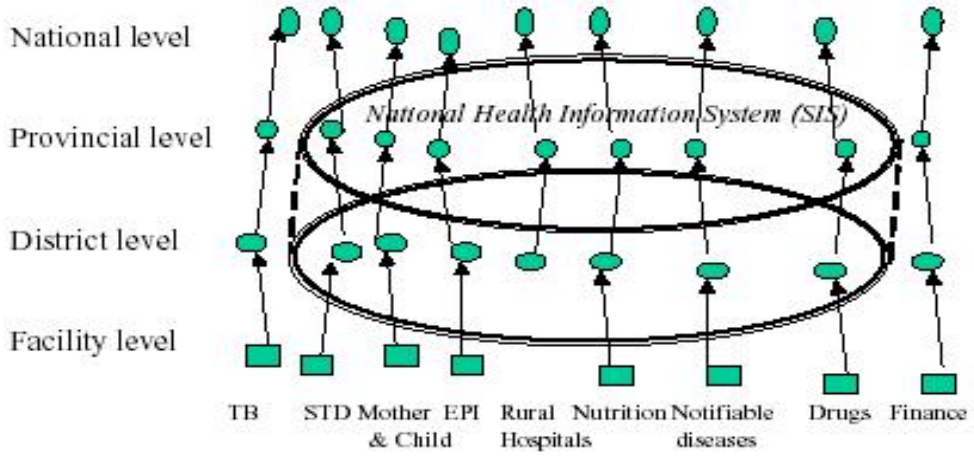


Figure 17: Flow of data in vertical health programs. Note the absence of vertical communication (Braa, 2001)

The figure is illustrative for the level of fragmentation in the Mozambican health sector. As one may see, the different vertical programs function without any communication between them. See APPENDIX H for a table of identified computer HISs in the Mozambican health sector.

Donor funded health programs making resources unavailable; example

The following example shows that economic support from donors might affect positively development of a computerized HIS in general with some successful negotiation.

Talking with some course participants during the DPS/DDS seminar in Inhambane 2004, I got to know that actually all the district health offices in the province had functional computers. However, for the SIS workers, computers were available in only 8 out of 13 district offices. The problem was that computers donated for specific projects, or dealing with specific diseases, were held unavailable for other staff. People working for these projects, however as well under the MISAU umbrella, felt that the computers were their property; reluctance was high regarding sharing. The common reason given for not sharing was that they were afraid that if used by other departments as well, the space available on the hard drives would become insufficient for their own work.

A DPS consultant told me that the real issue was of another. The computers had more than enough space for everyone. It was rather a question of attitude, I got to know. When having to share technology with others, the users would have remained with less feeling of ownership, and this had probably much importance. Having access to something that others don't have can be seen as positive for the people in possession of it. The issue about ownership and unavailability can also be backed up by findings from fieldwork in March, 2004. In most places (DDSs) the computers, if any, were placed at the boss' office even though it would have been appropriate to place them somewhere else where more people could have accessed them more easily.

5.3 Decision making routines and use of health Information

I will here present important aspects regarding decision making and use of information in the HIS.

Power structures

It is decided in MISAU which data to collect in the Mozambican HIS. In a yearly meeting a committee is assessing it, and makes changes if seen it is seen as necessary (Apoio ao sistema de informação para saúde, MISAU, 1997). MISAU states that it is of high importance to balance between standardization and flexibility in the HIS to be

able to adapt to a continuously changing reality. The ministry is seeing flexibility in the sense of being able to change national standards (ibid.). In the latest revision of national standards (2005) several new data elements are added, but none are taken away, meaning augmented work load for health personnel. For instance, for the vaccination program, the amount of data had more or less doubled, after MISAU had decided to differentiate between normal health units and mobile health units.

For health management in Mozambique the only instances with own budgets are MISAU and the DPSs. It means that district level and below are more or less powerless regarding resource distribution always having to rely on goodwill from the province. Even if reported to the province, requests are often not taken into consideration. An example: Chilundo & Aanestad (2004) describe how a district had a request for 100 000 boxes of lancets (tools for collecting small amounts of blood, facilitating for instance malaria tests) according to their needs, but was only provided with a standard amount of 2000 boxes.

Information use and feedback processes

The *SIS* itself has no computerized systems for districts or below. However, in the paper system there is on almost every form allocated space, more or less ready-made, for calculation of important indicators (see APPENDIX G). Nevertheless, I almost never saw them in use. The fields were mostly blank, and if some kind of calculation was done, it was as often calculated wrongly as correctly. This is demonstrating that indicators are not seen as especially important for anyone. If they were seen as purposeful, the wrong calculations would probably have been corrected, and blank fields would have triggered response somewhere in the reporting chain. Knowing the importance of indicators to obtain useful information (Lippeveld and Sauerborn, 2000) these observations question the credibility of the SIS as an information provider for health management.

In one district office we found many fancy graphs on the walls. But when taking a closer look, they showed to be two years old. We were told that the graphs were made because someone from MISAU was going to visit, and since then the graphs had just stayed on the wall.

However, some positive signs were found as well. In one district office we saw indications of willingness to use the collected data to get information out if it. A lady we interviewed said that she usually made graphs in MS Excel from the data she got, and she showed us. Though, none indicators were in use, but a representation of data over time may function as an indicator. Nevertheless, because the only computer was placed in the office of the boss, she found it unavailable for optimal use, so she did not do as much analysis as she wanted.

A part time employee in one DPS told that she would like to have the data element “Vitamin A” included in their data collection routine, as provision of Vitamin A was important for the health of new born.

In many instances DDS staff complained about poor, or total lack of, feedback routines from higher levels. The counter answer by province management was that

feedback was given all the time, but the health staffs just did not understand what feedback is and for what use. Unfortunately, due to time constraints, we did not have the chance to go back to the district offices to investigate further. However, we still got some clues when we discussed with the province management how they were using health information. We had a hard time getting any concrete answers regarding information use. We were told that they all the time were using information to make decisions for the better, and that many examples could be given. The only concrete example they were able to show us, was a mandatory quarterly report to the ministry.

The report we were shown contained many strange numbers regarding immunization coverage rates. By definition, coverage can not be higher than 100%. However, most numbers were showing coverage rates between 150 and 300%. Something was obviously wrong. I asked the DPS management about it, and I was told that they could not do anything about it, since those were the numbers they got from the DDSs:

> "*We know that the data are obviously wrong; places where we have more than 200% coverage for a certain vaccine, we still get outbreaks of epidemics among the target population. What can we do? These are the data we get from the districts."*

At least there was an awareness of the problematic numbers, but less knowledge about how to handle them. Other HISP observations regarding feedback and use of information support the above: *"There seemed to be no feeling of ownership of the data and no pride in the reports made. Feedback was virtually non-existent, unless there were glaring gaps or mistakes in data entry. There was no evidence of active data use in planning of districts activities, supervision or in systematic monitoring and evaluation of program activities"* (Skobba, 2003).

However, some other parts of the HIS showed better tendencies of appropriate feed back routines and use of data. At one occasion I interviewed a lady in charge of the provincial epidemiological health program. The program is based on weekly reporting to easier being able to counter outbreaks of epidemics.

The interview went on while she was entering data into the computer. Two issues appeared a bit strange:

- There was no indicators at all in the system

I asked if the lack of indicators was very constraining:

> *"No, that is not a problem. We rely on information from the DDSs, and they know their areas quite well in regards of which values are normal or not."(DPS health manager, 2004)*

However, timeliness of the data introduced into the system did not seem appropriate. Data which were entered into the system were 6 weeks old. Taking into consideration that fighting epidemics is the responsibility of the province headquarters and requires fast response due to the constitution of typical epidemics, 6 weeks seemed very much:

I asked if the delay was normal:

> *"It is normal, but it is not a problem. If there are any outbreaks they (DDSs) will contact us on the phone or radio. It takes too much time for the information to get through the official system to be appropriate for reaction."(DPS health manager, 2004)*[8]

What the case shows is that the staffs are aware of the system's limitations regarding timeliness of the data and which consequences it might generate. To dam up for this a workaround has been made.

Computer and HIS literacy among health management

Districts

At a course for all health management from the DDSs and DPS in the province of Inhambane August 2004, we got a good impression of both skills regarding computer use and HISs among the participants. We knew that many DDSs struggled with inadequate access to computers. From that we assumed that computer knowledge probably was quite low. On the other hand, we knew that HISP had held courses for DPS and DDS staff many times earlier (see p. 85-87).

What soon became apparent during the course was that the skill level in general was quite poor. Most of the participants knew how to turn on a computer, but when seeing how they handled them, it was clear that most were not much familiarized with the use. Actions like moving the mouse around, or typing with the keyboard seemed difficult for many.

Not having access to computers when needed further reinforced reluctance of using them when available. I was told by a DDS manager in Gaza:

> *"Everyone here is allergic to computers; we don't want to use them. It is like driving a car; even if you have a license and at a point learned how to handle it, the skills get lost when you are not in position of maintaining them. Then you get insecure and more reluctant when you should use it again"*

Teaching about information use we found that the knowledge and understanding of health indicators were generally quite poor. To find out we used the following example: Calculation of still birth rate. The starting point was the paper system form B07 (see APPENDIX G). It has the data elements "Nados Vivos" (Live Birth) and "Nados Mortos" (Still Birth). To find the Still birth rate one should put "Nados Mortos" over the sum of the two data elements (and multiply with 100, if the percentage was gotten to be known). Almost none managed to solve the task. This

[8] Information about outbreaks of diseases of epidemic character even reached the local newspapers only a couple of days after the outbreak became known, showing the understanding of importance to inform about these issues.

very indicator is one of the indicators that are supposed, mandatory, to be filled in on the back side of the paper form (ibid.).

Another point to mention regarding skills is the instability of the work force. The health workers are in general not well paid, meaning that whenever they have a chance to shift work to get better salaries, it will be done. In a meeting with Mozambican HISP team members in February 2007 this problem was by the Health Minister seen as one of two main concerns for the contemporary public health sector.

Province

Among health management at the DPSs, computer use in daily activities was the norm. Less fear was traceable. However, none did ever manage to install the DHIS software without any help from HISP representatives. Using the ordinary systems was seen as comfortable, but not even the data entry screen could be reached in DHIS. Traces from former HISP training sessions were hard to find. Also at the DPSs knowledge about information use was scarce in most cases. However, among some staff members the importance of using health information for decision making was known, but without the knowledge of actually how to do it (see section above).

MISAU

MISAU is a big and complex institution. It was hard get a good overview. However, I will mention some aspects which had direct influence on our work:

- The people working with the information systems, those probably with most knowledge of them, were not in position to make decisions
- The people in possession of power to make decisions, were in general not knowing much about information systems
- No persons were trained in DHIS and just a couple of persons had any insight in the HISP philosophies

The aspects regarding MISAU will be further elaborated in [8].

Problematic data quality in the HIS

Population data are calculated figures made by the province annually and sent down in the HIS hierarchy (Skobba, 2003). However, the impression I got was that no one actually had any trust in these values. If there were any obvious incorrect information, the perceived cause was always that the population estimates were wrong. This seemed to be a general attitude at facility, district and province levels. The actual collected values were never seen as a source for errors. Typically the immunization program suffered much from this, as already seen. Mavimbe (2005) observed coverage of up to 700% in some districts in the Niassa province. In the ministry they were aware of these rates, and said that the province offices had been asked to find the reasons behind these wrong numbers.

Mavimbe (2005) found one explanation to these inflated figures to be discrepancies between official population estimates and local headcounts. In addition, MISAU has

set the target to reach 100% coverage of vaccination. The means by lower level management to reach these numbers has been observed even as to threaten to not pay salaries if the coverage is not reached locally (Mavimbe, 2005).

In addition, data quality for the health information system may suffer from busy staff. I was told by a nurse that it was not unusual to serve more than 60 patients per day. Even higher figures were reported by Chilundo and Sahay (2003), where they found the average attendances for nurses per day in a district in Gaza to be higher than 100. She told that, because of the magnitude of work, a normal routine was to register data for patients at the end of the day, rather than while having them there. The accuracy of the data will then of course be questionable. We spotted typical patterns of 5,10,15,20 as values registered in many instances, confirming estimation rather than actual counting.

5.4 Strategies and objectives for organizational development

I will now sum up objectives MISAU has set for the organization. These stake the direction and degree of changes seen as appropriate by the organization itself.

Integration strategies; SWAp and National Integrated Plan

Although experiencing rapid economic growth in recent years, Mozambique is still a very poor country. Based on a poverty assessment, the Mozambican government has designed a plan for reducing poverty (PARPA 2001-2005; Plan for Reduction of Absolute Poverty). In a response to the government strategy MISAU has developed the Health Sector Strategic Plan, 2001 -2010 (MISAU, 2001). In the plan, main health policies and objectives are elaborated. The plan for integration is addressing the challenges from mainly two levels:

- Integration efforts between donors and government with an aim of gathering various resources to a “pool” for use where it is seemed most appropriate.
- Efforts of integrating different parts of the HIS in itself

The plan includes the Sector Wide Approach to Policymaking and Programming (SWAp). The SWAp defines a method of cooperation between government and development partners (such as donors), a mechanism for coordinating support to public expenditure programs, and for improving the efficiency and effectiveness of resource use in the sector (I.H.S.D, 2001).

However, after efforts of integration of the SWAp program, evaluation has shown that coordination of donors and MISAU has been irregular and ad-hoc (Chabot, Heldal and Zorzi, 2002; Dgedge et al., 2003). Furthermore, when analysing at more peripheral levels as at health facility level, the effects from the SWAp seem to be negligible (Chilundo, 2004).

In addition to SWAp the National Integrated Plan for Community Health and for Communicable Diseases has been formulated. This plan draws up a strategy for integration of various health programs. Results are still remaining to be seen (Chilundo, 2004).

Some integration efforts are made at computer system level. With support from MISAU, a system for integration of different parts of the SIS is developed. The system SIMP was applied country-wide in the year 2002.

Quality, decentralization and integration

MISAU has acknowledged that several structural properties of the Mozambican health sector are less than optimal for being well functioning. They have adopted the WHO (WHO, Alma Ata, 1978) approach which emphasizes the importance of decentralized power structures, with local use and analysis of data facilitating local appropriate decision making in the field of primary health care. This is for MISAU a long term reform, with a focus on decentralization and local governance characterized by the gradual empowerment of the provincial authorities and municipalities (MISAU, 2001).

In the document "Programa de Desenvolvimento do Sistema de Informação para Saúde, 2003-2005 (2010)"[9] (PDSIS), made official in November 2003, MISAU elaborate important factors of the existing sector as well as it sets targets and objectives for the approaching years.

In the chapter about main general objectives in the document, some typical institutional issues which set limitations for the HIS as it are documented. It is stated that *"…the motor of the organization is human resources."* (PDSIS, p.25). Several challenges for the organization are pointed out:

- Human resources in the organization and the organization in itself are suffering from problems typical for the Mozambican public sector in general
    - Lack of appropriate knowledge among health staff and management
    - Scarce resources regarding all aspects
- Due to the long tradition of bureaucracy and that very much data is sent to upper levels without analysis at lower levels, the focus is at an inappropriate point
    - The system is oriented around data collection and transferring of it, rather than around making decisions from it
    - Vertical power structures empower and reinforce more authority and respect rather than appropriate use of information

Several objectives and possible solutions are presented:

- It is emphasized that it is important to use the limited resources as well as possible

[9] Program for the Evolvement of the Health Information System

- By shifting the role of MISAU from a demanding agency into an agency for monitoring actions and supporting lower level needs, change will be facilitated
- To accomplish targets of better use of data, local understanding and local use of information is seen as important
    - Capacity building at all levels in the hierarchy is crucial to obtain a better information system
    - There should be laid more importance on quality than quantity, as the document states: *"…it is important to obtain the maximum amount of information with the minimal appropriate data sets…" (PDSIS, p.13)*
- Enable analysis of data to obtain appropriate information with proper tools
    - The tools should have typical functionality as; validation of data, identifying necessary information, calculating appropriate indicators with possibilities of comparing with earlier periods, and making adequate reports with possibilities of graphs to monitor tendencies, flexible indicators and analysis (PDSIS, p.49-51).

This should apply for all levels in the HIS hierarchy.

The document suggests that a localized version of the DHIS software supports the needs for the Mozambican HIS by supporting and enabling the changes ought for by the objectives. It should gradually absorb the existing software systems SIMP, Sisprog, BES, and other specific or local applications (PDSIS, p.36-37). This will lead to a more integrated and standardized HIS with less duplication of data, and with easier, in the HIS hierarchy, horizontal comparison and communication (PDSIS, p.36-37). A plan for when and how the development should be is shown in the following table:

FASE 1	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
MANTER O SIMP	xxxx	xxxx	xxxx					
SUBSTITUIÇÃO DO SISprog	xxxx	xxxx	xxxx					
MANUTENÇÃO DO SISprog	xxxx	xxxx	xxxx					
FASE 2	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
EXPANSÃO DO SIS.D A TODO O SIS		xxxx	xxxx	xxxx	xxxx			
INTRODUÇÃO DO SISD NAS US		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	
FASE 2	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
SIS.D NOS DISTRITOS			xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
FASE 2	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
INTERFACE INTEGRADORA		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

Figure 18: Showing the MISAU plan for the computerized HIS until 2010 (PDSIS, p.37). (SIS.D = DHIS)

5.5 Summary

The health system in Mozambique faces some of the same challenges as the society in general. Lack of (educated) work force and other resources is seen as a major problem for health care services. The systems I have mainly dealt with and studied have several problematic aspects around them, both in regards of system design and functionality, and problematic support. In addition, as the years have passed since the

introduction of the first computerized HIS, several new systems have appeared into the HIS context. Fragmented efforts (from for instance donor funded projects) and restrictions in old systems have made a more complicated HIS. The routines around the HISs seem to be typically data-led by nature. Much data is collected, but it seems that the real use of the data to obtain information for appropriate decision making is rather scarce. MISAU decides the content of the HIS and in general a typical issue is lack of communication downwards in the HIS hierarchy, and upwards regarding other issues than required health data.

Many of the challenges in the health care organization are acknowledged by MISAU. Several strategy documents and plans are formulated to counter current problems. In the end of 2003 the PDSIS was made official, where concrete objectives and instruments for reaching these objectives were indicated. The HISP approach and philosophy for information culture with its DHIS software was seen as an adequate actor for dealing with many the identified challenges.

6 SYSTEMS DEVELOPMENT: TECHNICAL ISSUES

Systems development, or systems adaptation, is an important part of the HISP philosophy to ensure that the HIS tools are better supporting the local contexts. In this chapter the more technical parts of systems development efforts will be described. However, throughout the time the Mozambican HISP project has existed systems development and adaptation have been a part of the HISP efforts. I will initially give a brief summary of important issues regarding the processes which took place before I was there. Putting it all into an historical perspective will give a better overview of the efforts. Secondly, I will present our systems development work from when I was there. Towards the end, I will assess the requirements behind the solutions, and in addition evaluate the modules we made, taken into consideration the current contextual challenges and problematic issues with the existing systems.

Sections:

6.1 Systems Development Processes before 2004

I will here sum up the systems development done with the DHIS software to better align it to the Mozambican context. However, this part can not be totally separated from the implementation efforts and alignment processes as the Mozambican HISP team tried to apply a variant of the participatory design method, by Kimaro and Titlestad (2005) called participatory customization. This implies that the DHIS software was not built from scratch for the Mozambican context, but it was rather customized to better fit into it.

Customization of Software

Due to the DHIS software's inbuilt flexibility, the customization process of it was relatively easy technically. However, some challenges had to be addressed.

Originally (1998) DHIS had no support for other languages than English. English is in general not well known in Mozambique, so translation to Portuguese was needed. Every text string in the software was hard coded, which meant much work for every update of the software. As a consequence DHIS eventually became multilingual (2000?).

A challenge of linguistic character arose during the translation process. The health workers were using other terminology than the translators were aware of. For

instance, the HISP and DHIS word “data element” was translated into “elemento de dados”. None of the health workers understood this, because the term used in Mozambique which had the intentional meaning was “Variável” (Variable). So, it was realized the translation had to be taken much more seriously with closer cooperation with the real users.

A ready translation to Portuguese was still not finished when I was in Mozambique in 2004.

The hierarchical structure of the HIS in Mozambique had to be represented in the DHIS database. In the Mozambican HIS there are 4 levels in the hierarchy opposed to the 5 in South Africa and in the DHIS software. Countering this difference a “dummy” level with no actual practical impact was placed in the DHIS database.

Content design processes

To be suitable for the Mozambican context the DHIS software had to support the content of the HIS. Through interviews and observation of health workers, document analysis and systems analyses the content of the current HIS became known (Puri et al., 2004). The idea was to support what was already there in regards of collected health data. With expanded analysis possibilities through the DHIS crucial issues could then be pinpointed.

During training sessions health management got to know the possibilities of the DHIS regarding its flexibility, and at several occasions it was asked for inclusion of data elements that the current systems did not support (ibid.).

I was told by a Mozambican HISP team member that conventional participatory design principles, which is normally an embedded part of the HISP approach for systems design to minimize resistance and better align systems and practice, was challenged by the Mozambican context. There were several reasons:

- Low level of HIS knowledge in general, and of computer systems in particular among health management
- Centralized power structures, meaning that decisions regarding systems design and content was primarily seen as a task for MISAU

Manuals

Two types of user manuals were created. One was a normal user manual explaining the software. The other type was about how to conduct courses for health staff. It was made slides and papers split into themes for the whole HISP philosophy and the teaching of the DHIS software.

6.2 Systems Development Processes from 2004

The main objective for the project while I was working in Mozambique was to replace two existing, problematic technical systems with the DHIS software. This section will describe the technical development in the light of what exists in the HIS context already ([5.2]), and requirements which had been formulated by MISAU ([5.4]).

6.2.1 New requirements for the software

Recognizing the aforementioned problems of the existing technical systems (see [5.2.2]), HISP suggested the DHIS software, which was meant to solve most of the problems. However, in order to use this software, substantial customization work was needed. Much of the work had already been done by other HISP Mozambique team members before I joined the team. Beforehand translation of the user interface from English to Portuguese had been a time consuming task. In addition, the DHIS database had been set up with organizational structure and data elements aligned with the Mozambican health sector context. My involvement started in March 2004, where making a customized data entry user interface for the DHIS and creating a connection from DHIS to SIMP were main requirements from MISAU. I will give a narrative description of what other HISP Mozambique team members and I have done on this regard.

Technical Requirements

Our technical work was pushed by MISAU as they, in November 2003, had given the official acceptance of the DHIS as the tool of reference for the HIS in Mozambique ([5.4]). For that purpose, DHIS had to fulfil some technical requirements in addition to what had already been done at earlier stages. According to the plan from MISAU, the DHIS should primarily replace Sisprog, and then gradually encompass more parts of the HIS. The absolute requirements for technically enabling the replacement of Sisprog will first be presented. Then I will describe additional requirements that emerged from MISAU.

Absolute requirements

Replacement of Sisprog with DHIS implicated that the existing technical HIS structures had to be taken into consideration:

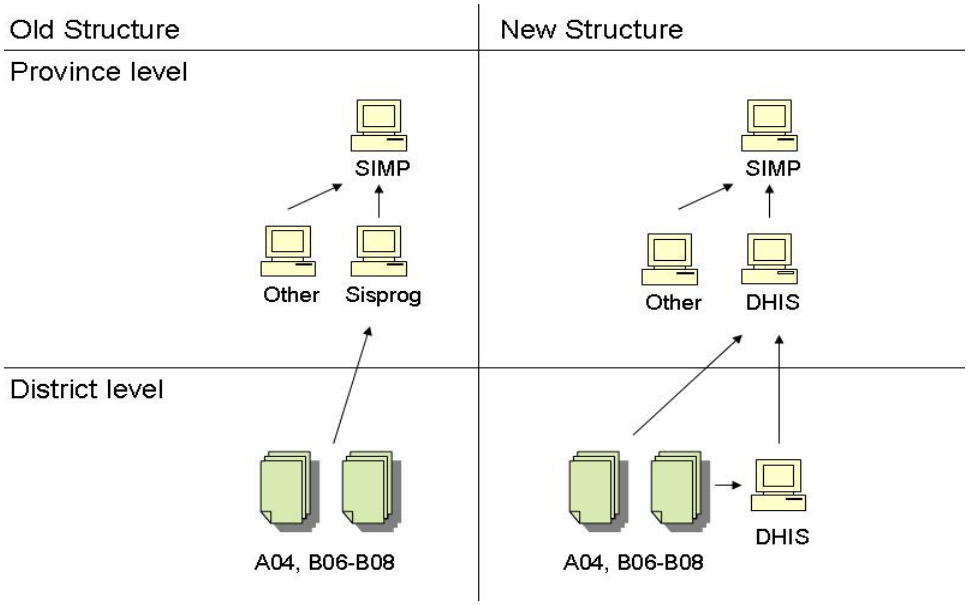


Figure 19: The old and the planned new structure

DHIS should then support the following:

1. The possibility to introduce the same data formerly introduced into Sisprog.
2. The data from Sisprog was currently imported by SIMP for analysis and report generation. MISAU wanted to continue the use of SIMP. A link between DHIS and SIMP had then to be enabled, so SIMP could import data from DHIS. Two solutions were mentioned, which will be discussed briefly in the next section.

Additional requirements

In addition to the absolute requirements, two other functionality requirements were given for DHIS before it would be accepted. MISAU saw these issues as highly important and needed:

Improved data entry user interface
Under the influence of an EC consultant it was decided (see [8.2]) to make the DHIS data entry user interface structured as the paper forms instead of only having a long list of data elements. DHIS had no support for customized data entry design as of then, so an addition would have to be made in DHIS supporting this.

Standard reports
The ministry saw a need for "standard reports". These reports are actually an exact replica of the hand written reports that are now produced and sent from the DDS to the DPS. So, for instance, the report for the paper form B06 contains the exact same data in the exact same format as the original B06, but with numbers and letters printed by a computer instead of written by hand. The making of the reports will not be described in detail, as I did not take part in designing them. However, the appropriateness of them will even so be commented upon towards the end, giving clues about appropriateness of work and priorities by MISAU.

6.2.2 Implementation of the requirements

I will now give a description of the development work we did.

First part: 2004-2005:

Connecting DHIS and SIMP

Because of the ministry's requirement of still using SIMP as a reporting tool to them, it was necessary to make it possible to port data from DHIS to SIMP. Two different solutions were discussed:

A: Structure DHIS data in the DHIS pivot tables
The first solution discussed was to make a standardized structure in the DHIS pivot tables. Then SIMP could be altered so it could read and import data from these tables. This was agreed upon between MISAU and one of the main developers of DHIS in a workshop January 2004. An advantage with this solution is that it could have been quite flexible, giving a general interface between the two applications.

However, there was never any more communication between MISAU and the DHIS developer around this, and nothing was ever done about it. When we, the students working with the customizations, heard about it, we had already started to make our own solution, and decided to continue with this as it was meant to be ready within short time.

B: Structure DHIS data as structured in Sisprog
When we initiated to work on the connection between DHIS and SIMP during our field trip to Inhambane and Gaza in March 2004, we did not have any specific knowledge about the SIMP crew in MISAU. We therefore chose to make a solution without the necessity of their involvement. The idea was to structure data from DHIS in tables exactly like how the Sisprog data was structured. Then SIMP could read the files as if they were made in Sisprog.

Replicating the Sisprog tables

The concept was easy; making queries that extracted data from the DHIS database, and paste them into tables structured as the Sisprog database. For a full description of the structure of the Sisprog tables, see APPENDIX A. There are several differences in the database structure of Sisprog and DHIS. For instance, Sisprog defines an orgunit by three variables; province name, district code and orgunit code. In the DHIS database only one variable is needed; orgunit code. Note that "orgunit code" here are internal codes in the different tables, meaning that there is no connection between their formats. Issues like this made it necessary to make tables internally in the export application which functioned as gateways between the different database structures. To get a unique value from the DHIS routine data table, three variable must be known; Period, Orgunit and Data Element. Below a graphical representation of the technical solution is provided.

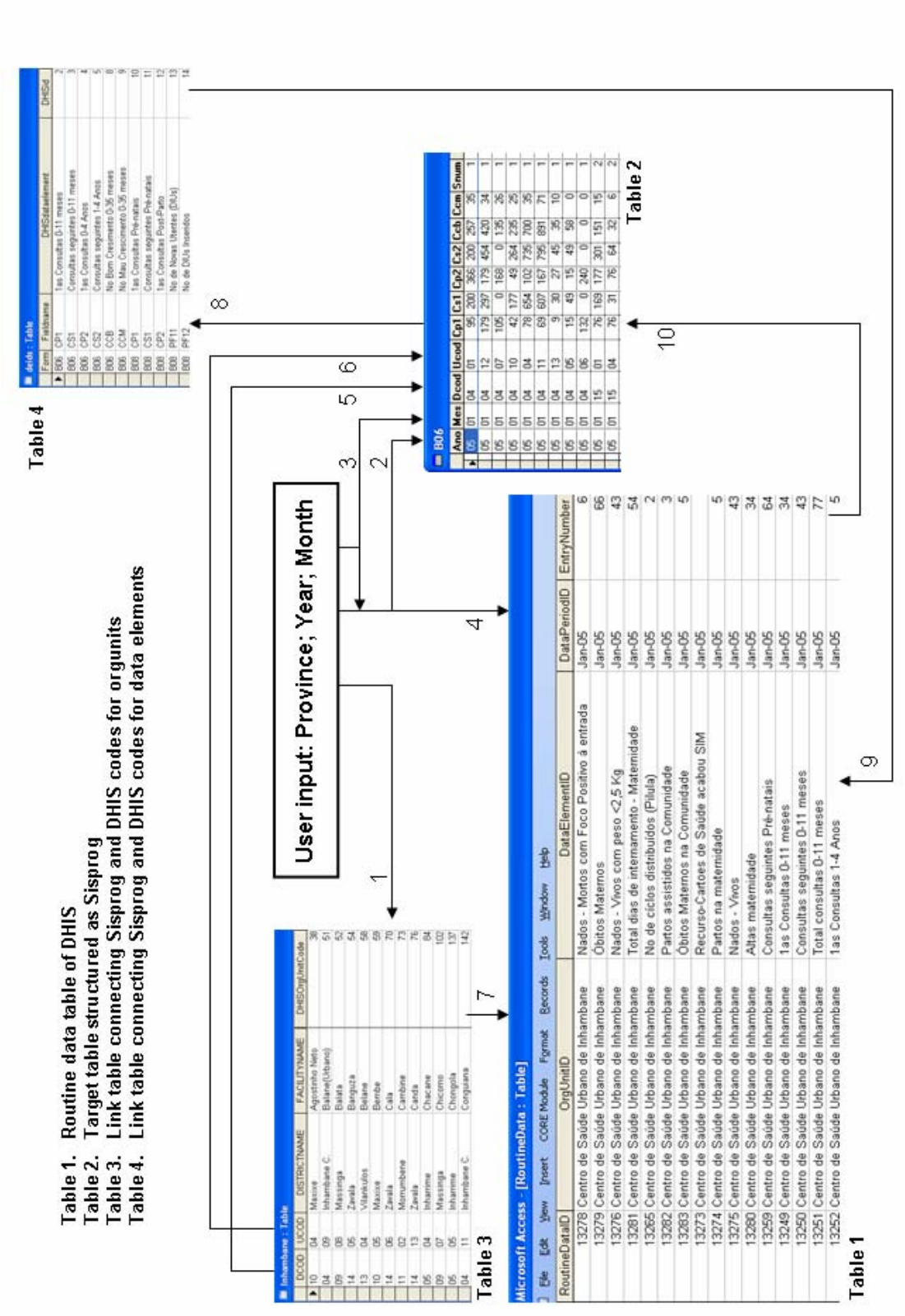


Figure 20: Necessary relations and directions to manage to structure data from DHIS into Sisprog format

Description of arrows accordingly:

1. From user input the right internal province table is selected.
2. From user input the correct year is inserted in the target table.
3. From user input the correct month is inserted in the target table.
4. Combining year and month from user input the correct DataPeriodID is found in the DHIS routine data table.
5. The application then starts to fill in Sisprog district code taken from the internal link table nr 3.
6. Subsequently it fills in Sisprog orgunit code taken from the internal link table nr 3.
7. The link table so provides the correct DHIS orgunit code for the current orgunit, which then can be selected from the DHIS routine data table.
8. From the target table the current Sisprog data element code is provided.
9. In the internal link table nr. 4 the current DHIS data element code can then be found and selected in the routine data table in DHIS.
10. The three necessary variables to find the correct value from the DHIS database to be inserted into the target table is now found, and the value is inserted.

However, while doing the initial testing, SIMP was not able to import the tables we had made. Deeper understanding of Sisprog and SIMP was needed, and the exploration commenced. In addition to our own systems investigation the SIMP developers assisted. Though, at many instances as well the SIMP team had problems identifying what was wrong. Eventually, after a period of research we finally found all the causes. Several “special cases” embedded in the Sisprog files which also were reflected in the import procedure of SIMP had to be taken into consideration.

How SIMP reads the files according to what Sisprog produces:

- Data cells in the tables can never be empty. If there is no data from the database, a “0” must be written in the file. Sisprog make no difference between the value “0” and “no data entered”. SIMP can not read empty cells. In the DHIS database there is a distinction between the value “0” and “no data entered”. So, when producing the Sisprog table format from the DHIS database, a “0” must be entered where there is no data. This corrupts the original data, as one can now not see the difference between “0” and “no entered data”. However, this applies of course only to the exported data, not the original DHIS database.

- The tables must always contain data from every month of the year until the last month entered. This is because the Sisprog tables always have all data from the current year. SIMP takes this structure for granted, meaning that the first month in every table will always be interpreted as January and so on, no matter what the month number actually indicates.

- All the tables must contain data. SIMP tests all Sisprog tables before importing them. If one or more table do not contain any data, an error message pops up and none will be imported. There is an option to import one and one table at a time in SIMP, but even inside this procedure, all the tables will be checked for data. This had consequences for the DHIS application. Even if no data existed, “0” must be put into the target tables.

- Routine data are aggregated into district totals when imported to SIMP. But not always everything. Sometimes some data will remain not aggregated. For instance, for Inhambane, data from the provincial hospital of Inhambane remains un-aggregated at some instances.

- Among the Sisprog files SIMP reads the following ones: A04.dbf, B06.dbf, B07.dbf, B07_Reg.dbf and B08.dbf. The two aggregated data elements in the backside of the form B07, is put in B07_Reg.dbf.

So, eventually, after taken all special cases into consideration we managed to get everything to work. However, for appropriate use, the DHIS database had to be aligned to the reality of the health structures. We made sure that all data elements were correct and that the organizational hierarchy in the database reflected the actual situation with assistance from MISAU and DDS staff.

The final product

The users have to initiate the export of data from DHIS to SIMP themselves. After data entry, an own module has to be started from a short-cut on the desktop, in which the user can choose which month to export to SIMP. The export will so be done, and the data will be in SIMP the next time it is started.

Customized data entry user interface

Initially, it was agreed upon that an EC consultant working for MISAU was going to make the customized data entry module for the DHIS (see [8.2]). However, the work was soon discontinued. We then had to make it ourselves to fulfil the requirements from MISAU about DHIS (see previous section). We were told from the ministry that it had to be approved there before we were allowed to test it among users. This means that we were not able to get any possible valuable input from the real users of the system during the design and development process. However, the requirements were clear: The data entry interface in DHIS should follow the design of the paper forms.

I will sum up some important features of the original module we made:

1. The result was a user interface that resembled very much the structure of the paper system, see appendix G for screenshots.
2. The module was intuitive and easy to use. It took 1 minute for a data entry clerk in Inhambane to master it.
3. The module was made separately from the DHIS core module, which means that it was possible to run it without having DHIS running.
4. It was possible to start it from within DHIS, meaning that it could appear as an integrated part of the DHIS core module.
5. Originally it had very weak data validation possibilities. It was possible to see the min/max values of the data element in focus, but nothing happened if the entered value exceeded the limits.
6. Neither was it possible to run the inbuilt validation rules from the DHIS directly from the data entry interface, since it functioned as a separate module from the DHIS core.

7. Change in design and/or data elements in the data entry forms had to be done by a computer programmer, meaning loss of important flexibility compared with the DHIS core module.

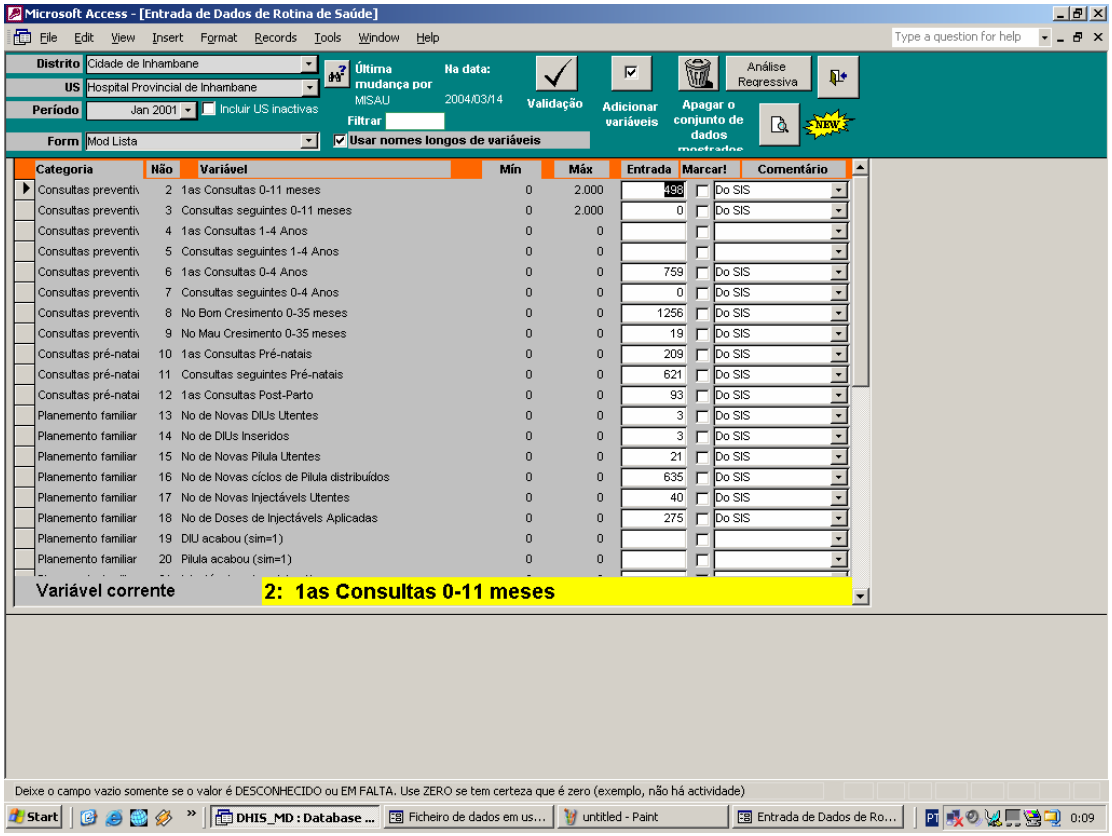


Figure 21: The original DHIS data entry user interface; list format

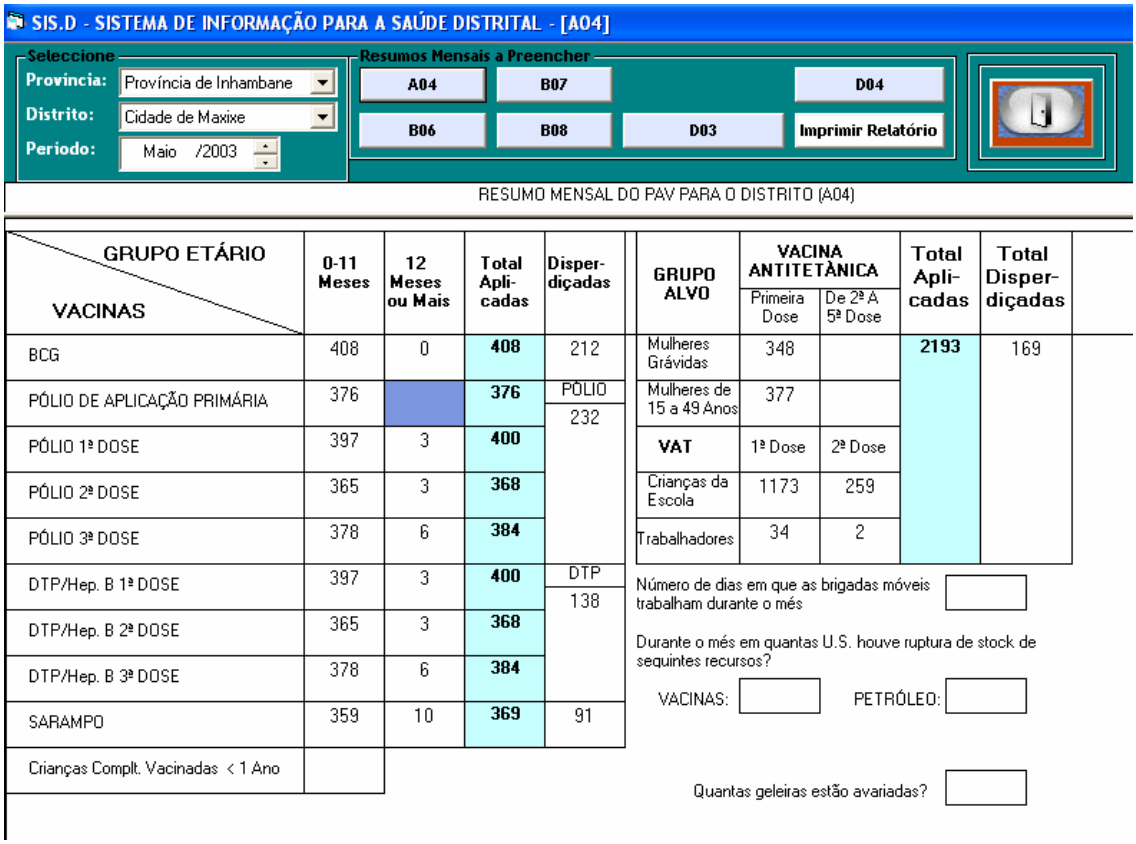
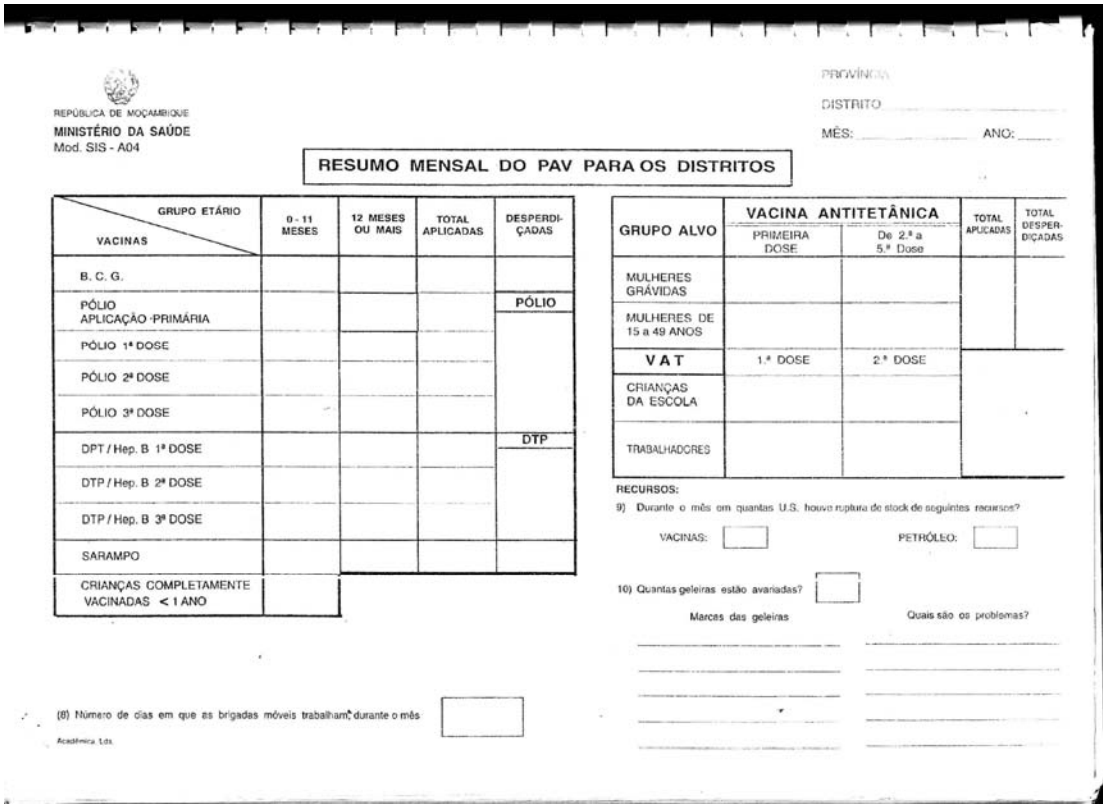


Figure 22:Customized data entry interface. See similarities with paper form A04:



Additions to the original customized data entry module

Data validation
An important feature of the DHIS software is the possibility of doing data quality control, with user generated validation rules and min/max values at data entry. Since the initial customized module we made did not have these features embedded, I decided to make them. To further satisfy MISAU, I made sure that the validation possibilities were at least at the level of SIMP.

Unfortunately there was not time for me doing it while staying in Mozambique, so I wrote in my report to the Mozambican HISP that this should be done by someone. After not getting any feedback for several months I decided to do it myself from Norway.

I made three types of data validation:

- The first solution was to compare the same data element with what had been entered one year earlier. The boxes were then given colour codes indicating differences between new and old data, exactly as in SIMP. The more distance between old and new values, the darker were the colours. The function could also be expanded to averages of different periods of historical data.
- The second solution was to compare data with minimum and maximum values for the current data elements. If outside the set range a colour code was given.

Both solutions are working in real time, meaning that immediately after entering a value evaluation will be done. The two validation sets are not shown at the same time, for not being too confusing, but with a click of a button it is possible to change between them.

- The last solution was to implement the validation rules of the original DHIS. The rules are user defined, and are typically checking for logical inconsistency between data values, or probable relation between data values. The function I made runs validation of all province data from all periods entered in one session testing according to the rules. However, eventually I had to concentrate more on my writing of this document, so I did not complete it to work with all validation types. The task of finishing it was given to the Mozambican HISP team. If it was ever done, I did not get any notification.

Hospital module
Since a goal in the longer run is better integration of different health programs (see [5.4]), I will shortly describe a contribution I made to this. At the time being hospital data were not computerized in any systematic way I was told by a province manager. They would like to systemize it, so I designed a simple hospital module, so that they could easily feed the DHIS database with hospital data. The point of departure was the D04 paper form (see APPENDIX G), however some extensions regarding which data to collect were made.

Second part: 2006-2007 development

New version of the DHIS

Between June 2004 and December 2006 a new version of the DHIS software was developed (see [4.1.5]). From October to January 2007 I was involved in development work customizing the new DHIS to the Mozambican conditions. Several differences from the old to the new version gave guidance for how the new version could be adapted to the Mozambican context:

- The new version of the DHIS has an inbuilt designer for customized data entry, which means that it was not necessary to make a special one for Mozambique.
- New structure in the database meant that we had to make a new link to SIMP from DHIS. However, meanwhile, SIMP had not changed noticeably, so the challenge was only about data extraction from the DHIS database. The changes from the solution made in 2004 are of trivial character, so I will not go into details about them
- Because of the new database structure new MS Excel pivot tables had to be designed
- New functionality, as data set and data element group, meant that the Mozambican data file should be reorganized

In addition, we wanted to look at the possibility of a full replace of SIMP; enabling DHIS to become the main computerized HIS without the need for multiple systems.

New MS Excel pivot tables and new database definitions

In the new DHIS database new ways of sorting the content is provided. The definitions; data set, data set group, data element group, indicator group, organization unit group give all several possibilities regarding presentation of information. For instance, by defining appropriate data element groups, and sorting by them in the MS Excel pivot tables, gives easier analysis possibilities. I made several pivot table sheets.

Enabling replacement of SIMP

For enabling full replacement of both Sisprog and SIMP, with as little resistance as possible from the ministry, we decided to produce replicate of the output of SIMP using only DHIS. Following the challenges and solutions are presented.

SIMP reports
The issue became a bit more complicated than we first thought. SIMP consists of two versions; one for DPPC (health planning, typically the domain of SISD), and one for DPAG (budgeting and financial data). The DPPC contains 12 reports on 13 pages, while the DPAG contains 54 (!) different reports (some of them might be help sheets for calculations). However, at a meeting with staff at the DPS of Matola in the Maputo Province, we got to know that they were not using the DPAG part at all in the Maputo

Province. In Inhambane they used a couple of the reports we were told, and in Niassa Province a few reports were used as well, however stemming from a (probably) older version of SIMP. Making 54 reports for the financial part would be very time consuming relative to the time I was going to stay. In addition, knowing that probably very few parts of the DPAG SIMP are used around, we asked ourselves whether it would be appropriate at present time to make all reports. We decided to make only the DPPC reports. However, some financial data are transferred from the DPAG to the DPPC. Support for these data was completed.

We discussed mainly two ways of making the SIMP reports in DHIS:

1. Structure MS Excel Pivot tables to look more or less like the reports from SIMP
2. Make the reports with Crystal Report generator

An initial objective was to utilize MS Excel Pivot tables to make a "blueprint" of the SIMP reports, and to maintain the flexibility of the pivot tables at the same time. However, there were some aspects to have in mind regarding this.

- SIMP has some design issues that –could- be hard to replicate in the Pivot tables; many of the reports SIMP produces are less structured with a mixture of many different types of data and indicators, differently represented at the same sheet (see APPENDIX E). If we would not have managed to make the reports look like SIMP if they were made in Pivot tables, it could have been possible that it would have become an issue in the ministry, not getting what they were used to.
- If made in Excel Pivot tables, because of all the special design cases in SIMP, the result would probably have become more or less as rigid as ready-made reports anyway.
- An advantage of using Crystal Report designer is that the reports could be made to look exactly like the SIMP reports.
- Time was an important factor regarding the work. The least time consuming was probably to go for the Crystal Report design. All of the local students in the group had already worked much with this tool and already knew it well.

We decided to develop the SIMP reports by using the Crystal Report designer. In addition, all information that is possible to obtain via SIMP, and more, would also be available in the custom made pivot tables, however, structured differently but much more flexible.

SIMP data validation
Another obstacle in the road for SIMP replacement was to be able to give the same, or preferably better data validation in DHIS than SIMP produces. DHIS does not support the exact same data validation as SIMP. However, there are several other ways of validating data in DHIS. We agreed upon that the data validation possibilities in DHIS were of adequate quality, and that with very simple training health management would be provided with better data quality checks with the DHIS data validation.

An important point this time was to make sure all additional modules to the DHIS package would appear as an integrated part of the DHIS core module. This request was sent to the main developers in South Africa, and from the DHIS v.1.4.0.71 released 27th

of February 2007 all the Mozambican modules are embedded. This means that every module can only be started from inside the DHIS main screen, making it appear more integrated than the solutions made in 2004-2005.

6.3 Evaluation of appropriateness of solutions

I will now give a brief assessment of the tools we developed in regards of resolving some identified problematic issues (see [5.2.2]) of already existing software solutions.

Justification of requirements:

First I will assess justification of the requirements from MISAU, by looking into what the solutions mean for the context.

Appropriateness of a customized data entry user interface for the DHIS v.1.3:
When shifting the approach from primarily trying to introduce DHIS at the district level in the hierarchy, to the province level, there are in Mozambique structural differences in the paper based system which have to be taken into consideration.

The embedded structure of the data entry screen in DHIS v.1.3 has an inscribed routine facilitating alimentation of data from all health programs from one locale at once; having one long list showed on the screen. A typical use-case scenario is then to enter all data from one health facility at a time into the computer system.

However, in Mozambique the paper forms produced at the health facilities are being processed further at the DDS. Among other aspects, this process consists of aggregation of paper forms (into B06, B07 and B08). The aggregation changes the structure:

- In the DDS data are received from each health facility separately. However, at the DDS data are collated into paper forms containing data from every health facility in the district at every paper form. The new paper forms produced (B06-08) so contain few data elements each, but data from the whole province.

The problem in DHIS then becomes: On the paper you see all the health facilities from a district represented, and relatively few data elements. On the computer screen, on the other hand, you see just one health facility, but all the data elements at once. This means that while entering the data you will have to switch between health facilities on the computer very often, or you will have to switch between the paper forms very often. In addition to take more time, it will be more difficult to keep track on what has been entered and what has not, giving higher probability for missing records because of the bothersome routine.

Another reason is to keep data entry as simple as possible. When what you see at the screen looks like what you see on paper, it is easier to do typing error checks.

Appropriateness of standard reports:
This new routine is unnecessary, redundant and not cost effective because:

1. Where computerization of data is at province level, the reports are already there, written at the DDS. This means that printing new reports is a waste of paper and ink, as there is no point of having duplicate reports.
2. Where computerization of data is at district level, there will be no use of the reports as the data are already in the database of DHIS, entered from the reports received from the health facilities. If any information is needed, it is possible to see the same data in the data entry screen, or in the MS Excel Pivot tables which at the same time gives significantly enhanced analysis possibilities. In addition, when computers are at district level, the data is meant to be sent electronically to the province. Sending electronically and on paper at the same time is again a waste of paper and ink.
3. The information the reports produce is of limited value, as there are in general very few indicators in use, and no facilitation for appropriate analysis.
4. Developing a report generator takes time and hence resources; resources that could be used on other development and/or implementation efforts.

I never got any other reason from the ministry explaining the importance for these reports. However, I was once told by a consultant in MISAU:

> *"The standardized reports are very important because they are highly needed."(MISAU consultant, 2004)*

Link between DHIS and SIMP:
For fulfilling the requirement of SIMP continuance, the link between the applications must exist. In addition, it is backed up by relatively strong political support in the ministry. However, as seen in the beginning of this chapter, SIMP represents several obstacles for having a system that may support local differences and/or a changing environment in the organization. Taking this into consideration, reinforcing the legacy challenges by letting SIMP survive for an extended period might be unfortunate.

Specific solutions we made:

2004-2005 solution:

- The customized data entry user interface is as rigid as Sisprog itself, as it needs a computer programmer for alterations. It functions as a layer on top of the DHIS core module, and hence hinders the advantageous flexibility built in DHIS.
- The final compilation made by the Mozambican HISP team did not enable the modules to be "integrated" into the DHIS core module user interface, which may weaken inscriptions for using the rest of the DHIS apart from the customized modules
- By still functioning as a data feeder for SIMP, the advantages of DHISs flexibility is farther away in the same time as SIMPs legacy challenges are not resolved
- However, the DHIS may function at district level as well. This enables the DDSs with computers, to have a working HIS for their level, which enhance the

analysis possibilities and then being a possible source for decentralized empowerment
- Complying with the requirements from MISAU opens up a backdoor for HISP and the DHIS tool

2006-2007 solution:

- New user interface in DHIS enables the maintenance of flexibility with customized data entry user interface
- The additional modules function as integrated parts of the DHIS core module, making it easier to access the rest of the functionality of DHIS for the users
- By still functioning as a data feeder for SIMP, the advantages of DHISs flexibility is farther away in the same time as SIMPs legacy challenges are not resolved
- However, by being able to produce all SIMP reports directly from the DHIS database, SIMP is made redundant
- MS Excel pivot tables enhances flexible analysis for all levels in the HIS hierarchy
- Complying with the requirements from MISAU opens up a backdoor for HISP and the DHIS tool

6.4 Advantages of the new system

Below I will give a short example of advantages of the DHIS application providing some simple data analysis taking into use some of its compatible tools; MS Excel Pivot Tables and Geographical Information Systems (GIS).

Flexible analysis with MS Excel Pivot Tables

The current Mozambican HISs have limited data analysis possibilities. The current main analysis tool; SIMP, produces a multitude of ready-made tables/reports. Much information is embedded in the reports, but there are some problematic issues. For instance, the content of these reports can not be changed by the users, nor be presented in other formats, as graphs.

However, DHIS exports data to a ready-made database (named data mart) specifically designed for easy further export to MS Excel Pivot tables, and enables use of these in data analysis. A major advantage of utilizing pivot tables in analysis is caused by its flexible structure. Central in pivot tables is the internal relation between fields making it possible to do pivoting. It is then possible to do “any” type of analysis with the data and indicators combining any of them. In addition, graphs can be generated on a click of a button.

A restriction regarding the Mozambican HIS tools, is that analysis possibilities typically follows specific health programs, they contribute to fragmentation. However, the export from the DHIS database and the data mart makes sure that data

from any health program can be combined in Pivot tables for data analysis. For instance, by combining data from the health programs the Expanded Program on Immunization (EPI) and the Mother and Child Health (MCH) (see appendix X for definitions and detailed content) which are currently entered into Sisprog, however as separate programs without any integration between them in analysis, some new information may be obtained (the idea for this combination of analysis is inspired by Mavimbe et al. (2005)). The numbers presented in the figures below are extracted from MS Excel pivot tables containing data imported from Sisprog into the DHIS application were also indicators have been made. The table illustrates an important feature with the pivot tables; the ability to zoom in and out after needs in analysis.

Administrative Level	District	Province	National
Location	**Funhalouro**	**Inhambane**	**Mozambique**
		Coverage	
Mother and Child Health			
First antenatal visits (ANC)	96%	129%	97%
Institutional deliveries (ID)	28%	41%	36%
First post partum visits (PP)	54%	63%	44%
Expanded Program on Immunization			
Polio 0	97%	77%	65%
BCG	153%	106%	87%
DPT+HepB 3	141%	103%	73%
Measles	142%	94%	78%

Figure 23: MCH and EPI data and indicators in three administrative levels in Mozambique, 2003

Starting at the district, it is immediately possible to see problems with coverage rates for certain happenings, for instance provision of the BCG vaccine. It is by definition impossible to exceed 100% coverage rate. This produces three alternatives: 1) the collected data on number of provided vaccines are wrong; 2) the population figures are wrong; 3) both numbers are wrong. The only thing certain is that it can not all be correct. Assuming alternative 1: Especially, the immunization figures have a tendency to be very high. This is a general trend in Mozambique. For instance, Mavimbe (2005) reported up to 700% coverage rates from some district in the Niassa province. As well, as seen in [5.3] we observed high rates were we went. A possible explanation for these numbers could be the national push for having high coverage rates of immunization, which again is pushed by the international community (WHO, 200X). Maybe there is an over-reporting of the numbers. If this is the case, it could produce implications for how to look upon the two different health programs together, as the real discrepancies will then be less than what is appearing, giving consequences for priorities in health management (see the steep lines in the graph below). Assuming alternative 2: This was the reason we were given when asking about the impossible vaccination coverage rates in both Inhambane and Gaza provinces, among health management at all levels (see [5.3]). If other routine data collected listed in the table are correct as well, it means that for, for instance Polio 0, which has a seemingly good coverage in the Funhalouro district, is not as good as it appears. For example, taking for granted that the BCG coverage rate actually is close to 100% (which maybe is quite unlikely in itself), the consequence for Polio 0 is that the correct coverage rate is closer to 65% than the apparently close to 100%. Looking at institutional deliveries, the correct coverage rate then is approaching only 18%,

which is very low, only half of the country average. However, by looking at what kind of numbers that country averages are comprised of (for instance 106% for BCG and 129% ANC from the Inhambane province), makes it likely that as well country aggregates are less trustable. Alternative 3: If both numbers are wrong, it will be very hard to get ay reliable information out of them. However, by looking at the graph below, it is possible to see tendencies of relations between the different coverage rates from collected data.

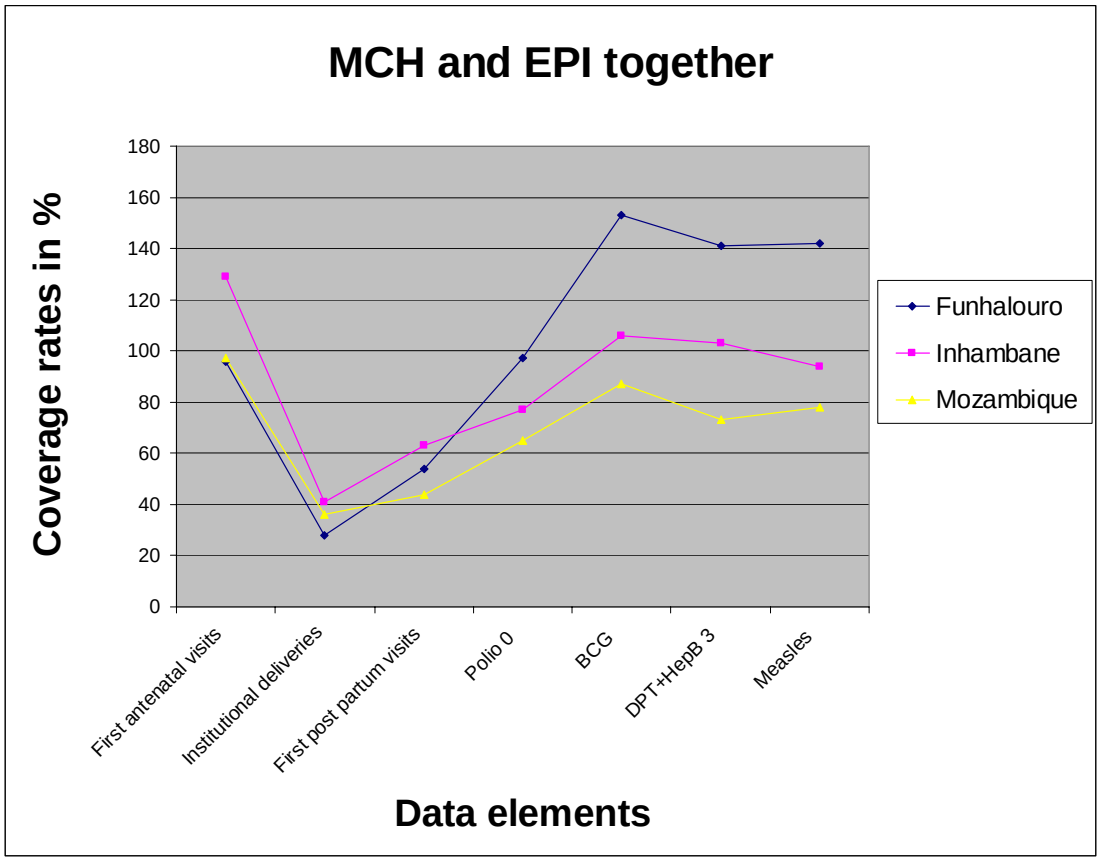


Figure 24: Notice that more than 100% coverage rate is impossible. As well, notice the general trends between hierarchical levels

Relations between indicators may function as an indicator itself. For instance, the tendency between BCG and DTP+HepB 3 is the same in Funhalouro district, Inhambane province and in the country as a whole. The same trends and relations are possible to see between the different health programs for every level in the hierarchy as well.

One thing that comes to mind when looking at the graph above is the general trend regarding coverage for institutional deliveries; it is very low. By making use of GIS this will be examined a bit closer.

Geographical Information Systems

Something missing regarding, for instance, the analysis possibilities in Pivot tables is an easy linkage between routine health data (and/or indicators) and spatial data (typically infrastructure, ecology, demographics, geographical distances etc.). GISs

are tools typically handling these matters by providing this linkage showing information on maps. While I was in Mozambique the HISP project got more and more involved in developing such systems tailor made for the Mozambican context. A short example is provided:

From the tables and graphs above it is possible to see that typically there are very few deliveries performed at health centres. This is probably unfortunate, as assisted deliveries are seen as safer for both mother and child (Bloom and Lippeveld, 1999), indicating that it is a potential priority area. Providing the information on a map gives new opportunities to analysis:

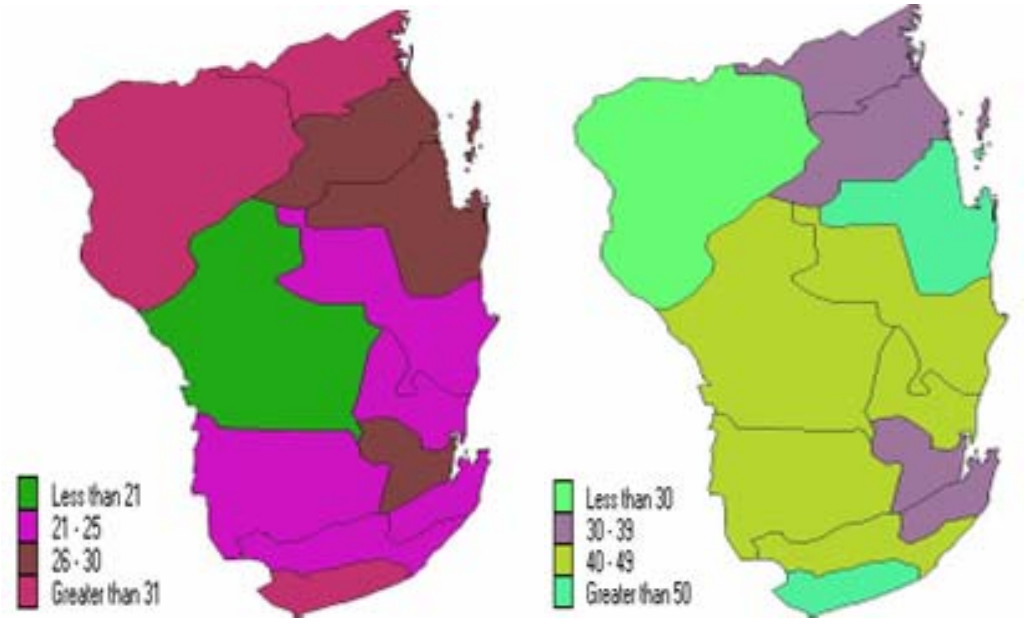


Figure 25: Left map: Coverage of institutional deliveries in Inhambane. Right map: Coverage of post-partum check-ups

For instance, the map on the left hand side indicates that in the district Funhalouro (the only district marked as green) there are relatively few deliveries done at institutions. However, if one then studies the map on the right hand side, it is possible to see that follow-up after birth is as good or even better in Funhalouro than in many other districts in the province. This may be an indication of that it is not necessarily the weight mothers are giving regarding the importance of institutional assisted deliveries which is the main issue for not going to the health facilities to give birth. If the trust in the public health sector was low, one could assume that it was low in general, not only regarding deliveries. By looking a bit further some clues may be provided:

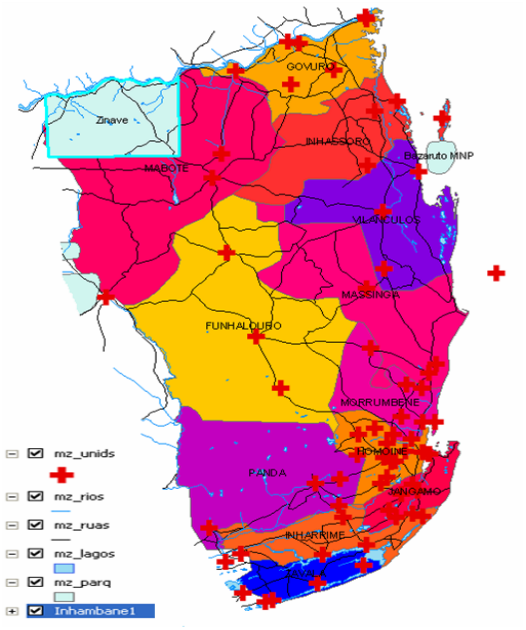


Figure 26: Showing available road infrastructure and health facilities in Inhambane

By studying the maps one can see that Funhalouro is a very big district. However, as the last map shows, there are few health facilities compared to the physical size of the district. In addition, the road infrastructure seems to be poor in parts of the district. Taking into consideration that from the time of first signs of a starting delivery until it actually happens may be relatively short, big distances to health facilities can be an explanation for the low coverage rates for institutional deliveries in the Funhalouro district. In addition, as seen in [4.2.4] road quality is in general poor as well, and in Mozambique there are relatively few people having own cars, especially at the country side. This might also explain the few institutional deliveries for the province in general, compared with other actions, as seen in the tables and maps above. Even where there are more heath facilities and distances are shorter, the relative distance compared with the time available before delivery may be insufficient for the mothers to reach them in time.

Discrepancies in information from same source

A thing to mention is the discrepancy between coverage rates provided by the table (which the graph is based on) and the GIS data. For instance, the table indicates a coverage rate of 28% for institutional deliveries in Funhalouro, while the map indicates less than 21%. The interesting point here is that both have the same data source, Sisprog, but has gone through different routes to get to the table or GIS. The DHIS table has data imported directly from Sisprog, and the data is so exported into the pivot tables without any processing. The GIS data is extracted from SIMP in Inhambane, however, which has imported data from Sisprog as well. I checked the population figures in the DHIS database and SIMP, and they matched. This means that the routine data have been changed in SIMP somehow. I was unfortunately not able to investigate this matter when I was in Mozambique, but there is data validation functionality in SIMP. Maybe this could be an indication of that it has been used? Anyway, for sure, the data have been changed by humans, as the systems export and

import data correctly. Then, I can only speculate in why the changes have been done and based on which information and which data to trust more, however something I will not do.

Creation of interest for health data via GIS

Another point to mention is that, at the course we held in Massinga in August 2004, the only thing that could compete with the collective interest created by the free lunch, was when one Mozambican HISP team member demonstrated a prototype of a GIS solution with data collected from Inhambane (the same application which has produced the maps above). Showing health data on maps was seen as very interesting among all course participants, indicating that having a GIS might not only provide different views of information, but might as well create interest for health data, something which seem to be a problematic issue among much health management in the Mozambican health sector (see [5.3]).

6.5 Summary

The original strategy for HISP in Mozambique was to align the content of the DHIS software with the current HIS context. Organizational structures and the data elements of the existing HIS were implemented.

When the HISP approach became an official part of the Mozambican HIS in the end of 2003, MISAU took control over the design process. Due to wish for replacement of the old HIS application Sisprog, and continuance of SIMP, a link from DHIS to SIMP had to be created due to the former connection between the two old applications. In addition, new requirements, as standard reports and a new user interface in the data entry had to be designed. A problematic issue with the customizations we made in 2004 was that, due to the complex and undocumented source code of the DHIS, we had to make them separated from the DHIS core module. Loss of important strengths of the DHIS regarding functionality and flexibility was the cost. However, the South African DHIS development team developed a new version of the DHIS software between 2004 and 2006. When we in December 2006 were customizing the new version of DHIS, an internal customized data entry interface designer had been included. There were no more any problems with lack of flexibility in the data entry user interface. The short analysis demonstrated advantages of flexible analysis, and generated information which would be hard to obtain with the existing systems.

7 IMPLEMENTATION EFFORTS

I will in this chapter describe implementation efforts of the HISP approach and the DHIS software in the Mozambican health context. First, I will give a summary of what has been done before I arrived. Then I will describe implementation efforts I took part in.

Sections:

7.1 HISP Implementation Efforts 1999 - 2004

HISP Mozambique has concentrated its efforts mainly from two fronts:

- Local level empowerment and creation of interest through training sessions
- Negotiation processes in MISAU to obtain support from crucial power structures

Both processes have shown to be dependent of each other. However, to make a better overview I will mostly separate the processes; describing implementation efforts in this chapter, and negotiation processes in the next.

7.1.1Training of health management

The Ph.D. students were in most instances the people doing the training of health staff in the provinces and districts in Mozambique. Training sessions were mainly built around three crucial issues:

- Increasing level of knowledge, understanding and interest around information culture and use
- Increasing level of IT skills in general, and the DHIS software in particular
- Facilitate potential for cooperation between staffs situated differently in the hierarchy of power

These themes were prioritized, as research revealed several challenges in the organization (Braa et al., 2001; Skobba, 2003):

- Skills regarding information use in decision making, computer use, and HISs among health management were in general low (ibid.). Provision of training about all important matters was therefore seen as essential. Just due to the fact that many districts did not have computers did not put them outside the whole

structure. To teach how to use and understand information without the presence of computers was seen as central as well.

- A significant challenge for the organization was a tradition of much bureaucracy in a strong hierarchical power structure. A goal therefore became to try to moderate these tendencies. Unifying staffs of different positions in collaborative groups was used as a means to facilitate this (Nhampossa, Braa and Kaasbøll, 2003).

Between 2000 and 2003 numerous seminars were given for district and province management in the HISP pilot provinces (HISP Mozambique, 2006). Participants were health management from DDSs and DPSs. However, some problems related to the training sessions have been identified by HISP research (Puri et al., 2004; MISAU, 2002; MISAU 2003):

- Typically the training sessions were conducted for all province and district management at once when all were gathered. An implication of this is that training was not given in the real life scenario
- Very limited, or no follow-up was usually the norm. If staffs should encounter any trouble later, for instance with software, there was no one there to help them
- Although acknowledged and included in plans at several occasions (MISAU, 2002; MISAU, 2003), the need for training super-users and support team was never initiated.

In addition some challenges have been pointed out regarding the actual use of DHIS among health management, which has always been a problem to obtain:

- MISAU never required use of the DHIS software, which meant that there was no implications for anyone if it was not taken into use
- MISAU never allowed the discontinuance of old routines for real piloting of the new approach
- Especially health management at DDSs was from before overloaded with work
- Without any support team, sustained effort was not achieved.

7.1.2 Installation and strategy for use of software

The DHIS software was installed in all DPSs of the HISP pilot provinces, and in all DDSs with computers. A strategy was developed for the DDSs which did not have computers. Two solutions were suggested:

1. Staffs from districts without computers could enter data into computers of the nearest DDSs.
2. Staffs could go to the DPS and enter data there. Medicines and salaries had to be collected from the DPS once a month anyway.

Potential problems with the solutions:

- People collecting medicine and salaries were not necessarily the same as were responsible for entering and analyzing data.
- Trustfulness of data is dependent on the messenger; if brought by a person with not much knowledge of the data the data is less trusted (Mosse, 2004).
- Time consuming task for the, from before, busy district staffs.
- In many instances poor road infrastructure makes the DPS less accessible, even inaccessible for periods due to weather conditions.
- Little accessibility to computers gives a harder time to use them appropriately when accessed. This could for DDS staff mean much time and work spent on something which did not give anything in return.

7.2 HISP impact in two HISP pilot provinces as of March 2004

By summarizing observations we did at a field trip to the two HISP pilot provinces Gaza and Inhambane in March 2004 it is possible to get an impression of HISP impact until then.

In 2004 HISP efforts in Mozambique had been going on for 6 years already. When visiting DDSs and DPSs in the two provinces in March 2004, we got an opportunity to look for traces after numerous of implementation efforts and seminars during the years. Following is a summary of the findings regarding the use of the DHIS software:

- The DHIS software was installed on every computer available for district and province management
- Some places the software did not function, although installed.
- However, when functioning, no one was using the software
- In fact, when examining the data entered into the database a pattern soon emerged. We also got it confirmed by the staffs when asking. Every time someone from HISP had been visiting, or when a HISP course was been held, data existed in the period in connection with this, however, never for other periods

So, after 6 years of piloting and implementation processes the bottom line is that the DHIS software was not in use at any location in the two provinces we visited.

However, HISP efforts had left some traces around. In DPS Inhambane we met much interest for both software and approach, and the management was very willing to do implementation together with the HISP team. Though, they had not taken any initiative to initiate any efforts themselves.

As well in DPS Gaza we found some interest for the software, as it could provide important flexibility. We were told by a DPS staff that she wanted to collect some data not included in their current systems. However, changing the routine was cumbersome at the moment, as the national standard was hard coded into the HISs in

use. Although she wanted, we were told that one of the reasons for not using the DHIS software, was that it was complicated to use, and hard to learn without anyone assisting.

This indicates that, although the software and the approach had become poorly implemented into social practice, some awareness had been created regarding that there is something that might enhance their quality of work out there.

7.3 Implementation efforts from 2004

I will in this section describe my contributions to the implementation efforts done by HISP Mozambique when I was in Mozambique. Initially, before I arrived, my plan was to stay for several months in one of the HISP pilot provinces for implementation work and support. My supervisor and I saw this as a good plan, because recent official acceptance of the HISP approach and the DHIS as the future HIS of Mozambique by MISAU meant that resources should be directed to implementation work. In the end, the plan was changed considerably, which will be commented upon below.

7.3.1 Training of health management

However, the implementation efforts actually performed consisted mainly of training of health management from DDSs and DPSs in the two HISP pilot provinces Inhambane and Gaza. The HISP approach acknowledges training of users at all levels as a crucial part of the implementation of the philosophy. To ensure greater chance for local sustainability it is highly important that local knowledge is built and maintained. At several occasions we also installed or repaired installations of DHIS, and we installed the customized version for the DPS in Inhambane.

HISP Mozambique was in August 2004 invited by the DPS in Inhambane to conduct a course with duration of two days for all health management of the province. I went there together with two other HISP Mozambique team fellows. In addition, some ad hoc sessions with DPS management staff in both Inhambane and Gaza was done at two occasions; March and August 2004.

HIS course in Massinga, August 2004

The course we gave was a part of a week long workshop for all district and province health management in the province of Inhambane. According to the invitation we had gotten, the main purpose of the course was to increase the knowledge of the DHIS software and how it should be used appropriately in health management.

The course was conducted in an active classroom environment. When teaching about the DHIS software, all participants had to follow what was taught by doing the same on their computers. All DDS staff that had access to computers had brought them to the workshop.

Two days is very short if one wants to teach the whole system and the use of it. However, we had gotten a draft from the HSIP coordinator, and had to follow the main points:

Computer use:

- Short introduction about computer and computer use in general

Computerized HISs and HIS in general:

- Introduction about HIS in general, and about the purpose of having a HIS
  - What an indicator is
  - Importance of indicators in for obtaining information for decision making
  - Importance of good data quality
- DHIS and advantages
  - How to enter data
  - How to do data quality checks
  - How to make an indicator
  - How to make simple reports
  - How to export to data mart
  - How to export and import between different hierarchical levels
  - How to do analysis in MS Excel pivot tables

Weight was always laid on reasons behind the different stages in the processes from input to output. We thought that if the course participants understood the possibilities of the system in connection with their daily work, it should be easier to get them interested in using it.

A thing we emphasized to all the DPS and DDS staff during the course was that if anyone had any problems of any sort using the system, it was possible to call for support. Everyone got phone numbers to the DPS staff, and the two Mozambican HISP team members provided theirs as well. The possibility to get support was repeated at several occasions as we wanted to try to initiate better communication lines between district and province, and HISP. We knew as well from the experiences obtained at the course that most of the participants were not yet skilled enough to be able to work with the DHIS application. After 3 months no one from the district offices had asked for any support. Taken the skills of staffs into consideration it could only mean the no one was actually using the system. No-usage was confirmed by another Mozambican HISP researcher when he went to Inhambane some months later to se how everything was working.

Ad hoc training sessions in Gaza and Inhambane

When in Gaza in March 2004 we were told by the DPS management that they would like to use the DHIS system, but they didn't know how. Trying to assist them we had an intensive course with a person that had the responsibility for computerization of health data. The lesson lasted for about one hour. Most of the same topics as from the course in Massinga were covered. In the end she said that it was difficult, and that too many new aspects were taught for her to be able to understand it.

When staying at DPS in Inhambane after the course in August 2004, I tried to teach some important aspects of the DHIS to the officer responsible for entering and analyzing data. His knowledge of the system was minimal from before. However, at the same time I had very much to do finalizing the customized applications so there was not enough time for teach him DHIS thoroughly. The only thing he learned properly was how to use the customized applications. The intention was at that time that some HISP team members should return a couple of weeks later, so thorough training could be done about the DHIS later as well. However, the HISP team never returned as planned.

Figure 27: The HISP team working hard together with DPS management in Inhambane

7.3.2 Planning for implementation with DPS management

We had strategy meetings with the DPS management in Inhambane in March and August 2004. The tendency was quite clear; the DPS management saw a need for improvement. They had several problems with existing computer HISs, and had as well a wish for taking the possibilities provided by DHIS into use.

The first meeting took place in the beginning of the IMSP field trip in March 2004. Some students, a professor from UiO and two staffs from the DPS participated. The discussion was about how to manage to embed the DHIS software into the context, and at the same time solve already existing challenges. The common consensus reached was that Sisprog should be replaced as soon as possible due to its problems and restrictions (see [5.2.2]). It was decided that the students should work on customizing the DHIS software to handle the replacement while staying in

Inhambane for that week. The work was so initiated, but not finished before much later.

Later the same week another meeting with DPS staffs was due. They told that a problem they had encountered regarding DHIS implementation was their lack of knowledge about it. It was of course then hard to teach other DDS staff about it, or use it. As my original plan was to stay for development and support work in one of the HISP pilot provinces, it was welcomed when they got to know that I could stay in Inhambane for a longer period. It was decided that I should return as soon as possible, hopefully in the beginning of April.

Due to both the negotiation processes in MISAU and the slow-moving development processes inside the HISP group, we did not get the chance to return to Inhambane before the end of August 2004 (see next sections). HISP Mozambique had been invited to Inhambane in connection with a workshop held by the DPS. We decided use the opportunity to work out some plans and strategies with the DPS management. Some decisions and agreements were made:

- Sustained training in DDSs and DPS should be initialized. The result of arbitrary seminars was seen as unsatisfactory. Two Mozambican HISP team members should return within two weeks and stay for a longer period for assistance.
- They should train at least one super user situated in the DPS, so that he/she could support and do further training when the HISP team had left.
- All DDSs in the province should be provided with computers and DHIS.
- The DPS should demand the use of DHIS for data reporting between the DDSs and DPS

This never happened. I had to return to Norway. The local HISP members returned only for a short stay, and in connection with another course given for the DDS and DPS officers in November. Neither was any support group for travelling in the districts created.

7.3.3 Installation of software

During our two-weeks field trip in Inhambane and Gaza March 2004 we found the DHIS installed on almost all computers available around. However, at several places it was not working. Where there were problems we assisted in sorting them out.

In connection with the course in Massinga August 2004, we had the opportunity to install the latest version of the DHIS software on every computer available for health management in the whole Inhambane province. At the same time we held the course so it might become easer for health staff to remember important functionality later.

7.4 Summary

HISP acknowledges training of health management as an integral part of implementing a HIS. Knowing to use the HIS software is important, but as much important is how to use it properly to support appropriate decision making. HISP in Mozambique has held numerous training courses and seminars for health management at all levels in the HIS hierarchy during the years of existence. Training sessions were concentrated mainly around three crucial issues: Increasing level of knowledge; Increasing level of IT skills and the DHIS software; Facilitate potential for cooperation between staffs situated differently in the hierarchy of power. Between 2000 and 2003 numerous seminars were given for district and province management in the HISP pilot provinces. Some problems related to the training sessions and implementation in general have been identified. Although adding up all seminars provided, there has in many instances passed much time between every the same people have been trained. A problem is limited follow-up after courses. Training of super-users and implementation support teams was never carried out. Another issue was that MISAU never gave permission for quitting old routines at the pilot sites, which means that HISP related work routines often would have become an addition to normal work.

What was seen in March 2004 when the IMSP went for a trip to two of the HISP pilot provinces was that actually no one was using the DHIS software, even though installed everywhere, and numerous training sessions had been conducted with health management at all HIS levels inside the provinces.

Due to complications in MISAU, I was not able to go to any of the HISP provinces as planned. However, we managed to conduct some training. At a course in Massinga, Inhambane 2004 we held a two-days course for all health management in the whole province of Inhambane. At some other occasions we also did more or less ad hoc training sessions.

We did several times set up strategies for implementation with province health management in Inhambane, but every time complications arose, and the outcome was less than optimal. No implementation or support structures were ever carried out or created despite high interest among health management there. Though, installation of the DHIS software was done for all health management in Inhambane.

8 MISAU: CHALLENGES AND POLITICS

During my time in Mozambique it became clear for me that MISAU is functioning as a strong centre of power, where instances lower down in the hierarchy had scarce possibilities of influence. Trying to align the efforts of HISP and MISAU was important for the HISP project. However, throughout the time the Mozambican HISP project has existed negotiation processes have been going on between HISP and MISAU at a rather regular basis. I will firstly give a brief summary of important issues regarding the processes which took place before I was there. Putting it all into an historical perspective may generate the opportunity to identify similarities and typical tendencies. Secondly, I will present our negotiation efforts from when I was there.

From the very beginning of the Mozambican HISP project, negotiation processes with MISAU for support have formed an important part of the project.

Sections:

8.1 Negotiation Processes and Outcome 1999-2004

Meetings between HISP and MISAU were initiated to plan strategies for implementation efforts, assessments etc. A group consisting of a local HISP team, MISAU consultants and HISP researchers and project leaders from abroad was composed. Between 2000 and 2003 several meetings were held, however with limited real impact regarding action for improving the situation. There were produced various reports about issues which should be dealt with, detailed plans for how to deal with the issues, and in the end evaluation, or reports, explaining what has been done and what should be further done (MISAU 2001; 2002a; 2002b; 2003). However, a common problem was to set plans into action. For instance, plans and budget formulated by HISP and MISAU for 2002; aiming at strengthen the Mozambican HIS and ICT skills (MISAU 2001):

- Strengthening the health and management information systems
    - Full DHIS diffusion in all HISP pilot provinces
    - Studying the spread and use of Information and Communication Technology in Mozambique
    - Technical assistance to MISAU about ICT and development of HIS instruments
- Continue support of Ph.D. and IMSP programs
- Training and continuous education of health workers and managers
    - Training courses in the pilot provinces to be further developed
    - Hold regular training sessions at provincial level, backed up by ongoing in-service support. Follow-up at least once every month

    - Create “information teams” and “super-users” at province and district levels for sustained improvements in information culture

Total cost was estimated, and budgeted, to be around 513.000$. By the end of 2002 a report on implementation activities were made, summing up the most important achievements in 2002 (MISAU, 2002b):

- Assessment of health information use in HISP pilot provinces by IMSP and Mozambican HISP team
    - Poor data quality
- Refinement of Training Manual for the provincial courses
- Three courses in Niassa province, March 2002; One course in Gaza province, September, 2002
- Continuous translation of the DHIS into Portuguese

In the end, no funding was provided by MISAU. The funding was dependent on creating Common Fund (Fundo Comun Geral). However, initiation of the fund was postponed several times, and in the end of 2002 it was still not functional. Only NUFU funding covered HISP activities in 2002.

In 2003 similar budget proposals were made by MISAU and HISP for HIS implementation. At a total cost of 485.000$ a 12-month plan for implementation was set up (MISAU, 2003). It was not followed up.

Actually, despite years of planning and acknowledgment inside MISAU of necessary action regarding reaching for a better functioning HIS, resources provided has only stemmed from the original NUFU funding of the HISP project. No other resources (money or personnel) have ever been allocated from within MISAU. A problem with the NUFU funding is that its budget is not explicitly giving room for salaries. It was therefore seen as an unavailable resource for that purpose. Not before late 2004 any money was allocated for hiring staff.

Dead-lock situation

While meeting activity was maintained another problem of unfortunate nature eventually emerged. There had still not been noticed any real differences in health information handling related aspects in the HISP pilot districts. While HISP meant that more top-level support and commitment were needed to be able to obtain any results, there was much reluctance in MISAU to give stronger support before any tangible results were shown; a typical dead-lock situation had been created. However, eventually the three pilot districts were expanded to include three whole pilot provinces. The thought was that it should be easier to obtain results if all levels of the health management hierarchy within a province were aligned. No more resources were ever provided by the ministry, and HISP had still only 5 Ph.D. students driving the implementation efforts. It was suggested that former HISP master students could be hired by MISAU to improve sustainability of efforts, but none got ever hired. The reason given was again the lack of results from previous attempts of HISP implementation.

The routine of having meetings was gradually weakened, and by 2003 it ceased. The momentum of the project as a whole was gradually lost. Apart from the reasons staked out above, other aspects also contributed:

- HISP team members, which mainly were the Ph.D. students, also had to take care of their own studies and other work. Focus had to be shifted from supporting any HISP implementation to finishing own studies. I was told by one of the HISP team members, also Ph.D. student:

  > *"We still went to the provinces from time to time, but mostly for our thesis work. If they had computers where we were, we helped them, but there was no sustainability in the HISP work."*

- In 2002 a company providing HIS solutions; EuroSys entered the scene. The EuroSys consultancy was contracted to develop a medium-term (5–10 years) strategic informatics policy of the health sector with a total budget of USD 55 million. However, eventually MISAU found the plan too ambitious and expensive, and cancelled the project.

Official acceptance for the HISP approach

However, in 2003, an assessment and a proposal for further strategy for development of the Mozambican HIS were formulated by HISP and MISAU consultants. Among other things, two students had made a data transfer application that ported data from the old existing systems into the DHIS software. Analysis of the data in DHIS demonstrated mainly two issues:

- The data in the old systems were of poor quality. However, the design and analysis possibilities provided were not good enough to being able to detect it.
- The DHIS software had superior analysis possibilities managing to show the problems of the other systems, and at the same time being a real alternative for the Mozambican context.

After all, in November the same year the document "*Programa de Desenvolvimento do Sistema de Informação para Saúde, 2003-2005 (2010)*"[10] was made official by MISAU. The document stated that the HISP approach and the DHIS software should encompass the future HIS for the Mozambican health sector.

This was the point of departure when I arrived to Mozambique. So, after a lot of ifs and buts it was believed that since the HISP approach with its accompanying DHIS software finally had been included in the official plans of MISAU, planning and implementation processes should be relatively smooth.

[10] Program for the Evolvement of the Health Information System the years 2003-2005 (2010)

8.2 Negotiation Processes and Outcome from 2004

Between April and June 2004 we had several meetings in MISAU. The meetings had their origin in new requirements set by MISAU regarding the DHIS software. Through these meetings I got a good insight of typical challenges met in the political sphere there. It soon became clear that reluctance for change, or reluctance to make definitive decisions and follow them, was the norm inside the part of the ministry we stayed in touch with. Further, lack of coordinated efforts, distance between plans and agreements, and action, seemed to have few consequences.

The first meeting in the ministry was with a MISAU consultant. We presented our findings from our field trip some days earlier, and suggested further plans for development and implementation, also accordingly to what we had talked about with the DPS staff in Inhambane. Our findings concurred much with the already made plans from MISAU ([5.4]). The way forward seemed promising.

New actors and challenges

However, already in January a consultant hired by the EC to work with HIS implementation issues in MISAU had arrived. Among his earlier tasks was an evaluation of HISP and the DHIS software package. The evaluation seemed quite thorough, where many strengths and weaknesses of the system were pointed out. A problem that was found as crucial was the user friendliness of the DHIS in general. Some shortcomings were pointed out:

- The data entry user interface did not follow the design of the paper system
- No possibilities for easy production of standardized reports

As an alternative solution to the DHIS he suggested that his own system, which he had made for Zimbabwe at an earlier stage, should be used instead. His suggestion was then to use his own system for main HIS tasks, as according to him was introducing data and producing standardized reports. If requested, it could be made an export function from his system to DHIS.

The HISP team did not at all like the suggested solution, and had as well problems of taking the consultant very seriously taking into consideration what his approach could offer (see [0]). Taken from an e-mail from a Mozambican HISP member regarding the new proposal:

> *"This looks like a fight between (the EC consultants) software and DHIS which on my point of view is ridiculous since MISAU adopted DHIS as the software to be used to gather data. It means that we shouldnt waist time looking at other software but to try to improve DHIS according to user needs."(Mozambican HISP member, 2004)*

Negotiations for support and solutions

To sort out the newly arisen issues it was decided to have a meeting in MISAU were the objective was to clarify how the process should go further from there. Meanwhile I was requested by a consultant in MISAU to hold my trip for Inhambane. I got to know that some people in MISAU had gotten tired of HISP talk that they felt never lead to any results. First the way forward should be decided in MISAU, and then we could look at possibilities for implementation work, I was told. In conversations with the Mozambican HISP coordinator about it, I was told to comply, as any conflict with MISAU was unwanted. All this despite that my initial plan was approved by both DPS management and the Head of the Department in MISAU.

The intention was to hold the meeting as soon as possible. However, it was postponed 4 times before it finally took place, more than a month after the initial date. That meant less time for me in Inhambane.

The HISP team at the meeting consisted of only students from the IMSP and the HISP coordinator. None of the original Mozambican HISP team members were in Mozambique at that time.

Some decisions were made at the meeting:

1. The user interface for data entry (computer screen having similar design as the paper system) in the Zimbabwe system was seen as better for the Mozambican setting, and the consultant that had developed this system was supposed to work on making a similar interface for the DHIS
2. Reports should be produced in DHIS made by HISP using the possibilities of flexibility in DHIS
3. Link between DHIS and SIMP was to be taken care of by the HISP team
4. Only one database should be used; the DHIS database
5. No matter what, Sisprog should not be discontinued at that point
6. No-one should go for implementation work in any province before the customized software was finished and approved by MISAU

The decisions had consequences for further processes:

- I could not return to Inhambane before everything had been finished and approved by MISAU, which means that potentially important support as asked for by the DPS would not be given anytime soon, which again could have a negative effect on sustained interest and efforts in the province
- Even if the new software was finished, a new decision regarding Sisprog had to be taken at a later stage, meaning that if we went back to a province for implementation, the two systems had to exist in parallel until MISAU decided differently
- The DHIS software was going to be the official system, however with changed data entry user interface. This meant that the technical challenges had to be solved in cooperation between the EC consultant and the technical HISP team consisting of only students

An important issue to mention is that soon a misunderstanding regarding point 1) in the list above arose. The original decision, as I have written above, soon got the meaning "the user interface of the Zimbabwe system should be used for data entry". This is actually quite different from the original decision, as the new meaning indicated that the Zimbabwe system would be used for data entry, and not specifically that a similar interface should be made for DHIS. Point 4) supports the original meaning, as it assures that there would be only one core application with one database. However, even in a minute from the meeting made by the Mozambican HISP coordinator point 1) was written in a way with multiple interpretation possibilities:

> *"…The data entry interface has to be improved. In this case the idea is to use the data entry screen the system presented by …is using".*

When commented upon, it was still not changed, and it became the official one in the end.

This probably made it easier for the EC consultant to make the decisions he made regarding the continuance of the original plans agreed upon in the MISAU meeting. After looking more into his tasks the consultant told that it would be almost impossible to make a connection between his type of user interface and the DHIS database. The reason for this, as he said, was that he wanted to use his own system instead (not very logical reasoning, and against the agreement in MISAU), and modify that. He said that he anyway looked upon his own system as the ideal HIS software:

> *"My system is the best! It is impossible to improve it." (EC consultant, 2004)*

Thus, he gave his real reason for not wanting more cooperation with HISP. He was positioned inside MISAU, and we; the HISP team, were a group of students from the outside. We had little power to make any changes to his decisions other than expressing disagreement.

He told he saw no point in dealing more with the DHIS and he chose to discontinue the support for the DHIS. If HISP still wanted to do anything, we were on our own, he said. Although, we decided that there should be communication between the HISP group and the consultant, updating each other on what was being done. Actually, as the consultant had become a bit tired of the conflict of interests between the different groups, he offered at one point to move to another part of the ministry, making HISP responsible for the further work. If these were just empty words is impossible to tell, as no initiative was taken by HISP to follow it.

We in the HISP team decided to continue to work on our own customized data entry and link to SIMP. However, after some discussion between HISP members it was determined democratically that the creation of the customized data entry should be kept away from the knowledge of MISAU until it was presentable.

The last meeting of importance between HISP, MISAU and the EC consultant took place in the beginning of June, 2004. The HISP group presented a prototype of the tools we had made. The meeting ended up in a big discussion. The issues discussed were about lack of communication between HISP and MISAU that had lead to double work, meaning that the EC consultant in MISAU and the HISP team had worked on the same for over a month. To smooth things out and please everyone, the other MISAU representative decided to look at the possibility to test both systems in province offices in different provinces. Later an evaluation could give a better insight in how the different systems would perform, it was said.

When I had returned to Maputo in July I got to know from a MISAU consultant that, as the outcome of the last meeting indicated, it had been decided that the system of the EC consultant should be piloted in three provinces where HISP never had done any work. This means that the new approach/system had become more or less a direct "competitor" for the HISP solution.

Bureaucracy and resistance for change

With the PESS (MISAU, 2001) and PDSIS (MISAU, 2003) the potential for willingness to initiate change processes seemed promising. Starting implementation work should not be far away when the official plans say so. However, what was experienced in real life revealed something else. The distinction between plans and action appeared quite clearly.

Regarding willingness, or the attitude for, changes, the degree of bureaucracy could be seen as important. Giving up support for old structures, even unnecessary ones, seems hard to accomplish:

As all Sisprog data are imported to SIMP and only used there in analysis purposes it was not anymore necessary to send the original Sisprog data to MISAU. However, MISAU continued the demand for the data in the original Sisprog format.

When I at a meeting asked about this and proposed the discontinuance of this redundant routine, the answer I got was negative. The answer I got was the following:

> *"The process of discontinuance of Sisprog is a long process which has to take much time. Maybe someone here in the ministry (MISAU) has responsibility for it. Extensive negotiation processes will then have to be initiated." (Head of Department, MISAU 2004)*

Another issue discussed was about design and content of the paper based HIS. Two aspects raised this:

- There were currently plans of doing changes in the paper based HIS. However, the old computerized HISs could not be changed, so limitations for alterations existed

- However, the new DHIS system had the flexibility to support any changes in the paper based HIS

I suggested that we could try to coordinate the efforts of customization of the DHIS and revision of the paper based HIS. I was met with scepticism. I was told by a MISAU consultant why that was not possible, much resembling the reasons which were given for earlier change proposals:

> *"Even the smallest change is extremely time consuming here in MISAU, and that even if it doesn't have any practical negative implications for anyone. No one wants to step on anyone's toes and nothing happens."(MISAU consultant, 2004)*

MISAU funding

Although the plans and MISAU objectives presented a working HIS of quite different character than the current one, there was never any talk about resource allocation for facilitating any changes. As well, HISP was seen as a project that should finance its own work, even though it was, according to the official plans, an integrated part of the MISAU strategy for improving the Mozambican HIS. However, in e-mail conversations with one of the MISAU consultants in 2005, I got to know that a budget for HISP implementation was allocated from the funding pool "AIDS National Plan". This was meant for hiring trainers at DPSs for supporting the roll-out of the DHIS. However, in the end, no resources were ever provided.

8.3 Summary

Characteristic for HISP project in Mozambique and its relation to MISAU, is that between them, many meetings have been brought about, many plans have been formulated, and several quite detailed and comprehensive budgets have been made. However, also typical is that many times these have not lead to the planned action. For instance, none of the budgets which were set up in MISAU for HISP implementation was ever materialized in the end. A reason MISAU gave for not giving stronger support for HISP processes was that they wanted to see results before more support would be given. However, the HISP group meant that more support and resources were needed for any impact to be possible. Other emerging HIS approaches also obstructed the meetings and activities.

However, eventually, in November 2003, the HISP philosophy and the DHIS software became an embedded part of the Mozambican HIS approach. Though, this also presented a shift in control of processes. From being a pilot project with much independence regarding design and implementation, MISAU took control over processes, and formulated special requirements for the DHIS software. Between March 2004 and June 2004 we had several meetings with consultants in MISAU regarding design, development and implementation of software and approach.

We were obstructed from going for more implementation work in the provinces before MISAU had approved the new customized software. An issue became that the new system should look as much alike the old one as possible. Or, to be more specific, be an electronic representation of the paper based system. The design of the data entry user interface became very important, and the consequences of the technical implementation of it into the DHIS were less thought of. The new DHIS had many restrictions which might compromise the officially stated objectives for HIS software and what it should support.

What seemed as being quite typical was that propositions which meant considerable change was usually turned down. It was also confirmed by other MISAU consultants that characteristically only minor changes were possible get through, and usually things took much time no matter what.

An outcome of the meetings we had with MISAU consultants was that a consultant who, among other tasks, primarily was doing an evaluation of the HISP project, got permission to pilot his own system. The Modulo Basico was going to be piloted in some provinces while the DHIS software should be continued piloted in the former HISP provinces. At current time the plan is to install the Modulo Basico country-wide.

9 HISP PROJECT MANAGEMENT

Several aspects have challenged the Mozambican HISP project during its years of existence. I will here in short sum up some typical issues.

Sections:

9.1 Challenges and Work for Solutions

Some aspects about the Mozambican HISP project have challenged it regarding reaching its objectives of being an implementation effort in addition to a research project. Several issues have been identified through the years, both internally in HISP and externally by MISAU consultants and other researchers (MISAU 2002, MISAU 2003, HISP Mozambique 2003, HISP Mozambique evaluation by external HISP researcher, 2003). I will sum up some of the main points regarding the problems of reaching sustained efforts for HISP implementation processes:

- Constitution of the group
  - Only students, no employees, meaning that much time passes for study related matters
    - Ph.D. students had to attend courses and do writing in Norway
    - Because of being students supporting own interests in work rather than immediate needs of HISP was prioritized
  - The group was strong in context and health related issues, but moderate in technical matters
    - Systems development processes took much time
    - Relying upon other master students who went away eventually
  - Bound to the city by family and other work
- Context related matters
  - HISP pilot districts and provinces far away from the capital
    - Less time spent at pilot sites
  - Mozambique is a country without social security. If you have a (possibility for) job you stick with it. HISP work was in general not paid except per diems for field trips with training, hence less prioritized
- Funding
  - Only money for research and education through main funding agency; NUFU. Resources for salaries was not allocated

By being a part of the Mozambican HISP team for an extended period, I had the possibility to get an impression of challenges in the project from my time as a team member. I found several of the same challenges regarding sustained HISP processes in Mozambique. Although many of the problematic issues had been identified several years earlier, it seemed like little was done to counter them.

Addressing sustainability issues in the HISP team

A long existing challenge in the Mozambican HISP team had been lack of stable work force. The Ph.D. students comprising the core team had in general been as much in Norway for studies as in Mozambique. When in Mozambique, other jobs and aspects of life further hindered HISP efforts, I was told by a Mozambican HISP member. In addition, although understanding of contextual challenges and health related matters was high in the group, technical competence was rather moderate. To counter this tendency it was in July 2004 decided that a student from UEM should be hired for HISP work. I had the responsibility to train him.

HISP training sessions 2004

The student to be enrolled had from before never worked within the Mozambican health setting, neither with health information systems. Many things had to learned and understood before the student could fully participate in any noticeable development or support work for the HISP team. I knew from my own experience that without any proper training, it would be hard, or at least time consuming, to gain appropriate knowledge.

The training was concentrated on two main aspects:

1. Increase the knowledge and understanding about the Mozambican HIS and its structures
2. Increase the knowledge and understanding about HISP with its visions and the DHIS software and the purpose of it.

We had together six sessions of training and lessons, about 12 hours in total. Further the student also had to do quite much work between the lessons, as I saw it as crucial to actively work with the system to be able understand it properly. In that way he would also gain knowledge about typical attributes of a health information system and familiarize himself with the meaning of words like data, information, indicators, reports etc. from usage and experimentation. Later he also, together with another HISP member, made a user manual for the whole DHIS we were giving to all the DPS and DDS staff in Inhambane.

The HISP group and issues 2004-2006

From 2004-2006 several aspects contributed to less effort in the HISP team:

- The Master students involved had to finish their own studies
- When they finished three out of four left the project group
- The Ph.D. students had to finish their studies.
- When they had finished they got less involved in the project than before

The master student, who remained in the project, was together with the student I had trained hired in the HISP project in 2005 until June 2006. They were going to fix the software we had made in 2004 which did not work as planned. In addition, a new version of the DHIS had to be customized. However, in the end they had to leave the project due to lack of involvement and accomplishment of the work tasks.

Meanwhile, to try to get a foot inside MISAU the main responsible for SIMP was hired by HISP. The intention was that he should provide an interface between the new version of DHIS (see [4.1.5]) and SIMP. However, he did no follow up work as agreed upon, and eventually had to leave the project.

In late 2006, it was again decided to hire students from the UEM for doing HISP work, mostly of technical character. When I stayed in Mozambique in December 2006, I conducted training again.

HISP training sessions and development work 2006

One of the main purposes of my final stay in Mozambique in December 2006 was to assist in training three informatics students from the UEM. The intention was that they were going to become and continue as a technical expert team for the Mozambican HISP team, and as well eventually even for MISAU. So, the aim was make myself redundant, meaning that the students should be able to give appropriate support and make changes and updates of the software themselves if necessary later. Two of them had during the last weeks prior to my arrival made some standard reports using the DHIS database as a source. The last one did not have any experience with the DHIS from before. We all worked quite intensively for almost four weeks, and accomplished the main development tasks, at the same time as they had managed to familiarize themselves with the DHIS software and the additional modules. In conversations with the functioning Mozambican HISP coordinators we decided that the three students were going to be sent to a summer camp for health management in South Africa, or that a course around the HISP approach could be done internally later, so that the students could get a better grip of the whole HIS area.

9.2 Summary

The HISP project has somehow been challenged by its structure of being an action *and* research project. The HISP project group has typically consisted of Ph.D. students who also have had own studies to take care of in between efforts of implementing the HISP philosophies into the Mozambican health case sector. In addition, it seems like there have been some problems of balancing expertise in the group in regards of actual needs. Typically, knowledge of health related matters has been very high, while detailed technical competence has been lower. The challenges have been acknowledged, and several efforts have been initiated to counter them. I trained a new HISP team member in 2004, and he was later hired for technical support as well. In 2006 I participated in training of three new students who are supposed to function as a team of technical expertise for HISP Mozambique, and as well later for MISAU.

PART 3 ANALYSIS, DISCUSSION AND CONCLUSION

10 ANALYSIS and DISCUSSION

In this chapter I will analyse and discuss findings from my case study. The case is described in the empirical enquiry of this thesis, encompassing the chapters 4 – 9. Analysis and discussions will be done in relation to this with support from the literature I draw upon in chapter 2, with the aim at exploring my research objectives:

Investigate conditions for improvement of Health Information Systems in a developing country's setting

This is a general aim of the thesis, and by investigating the concrete research objectives, the overall goal is to get a better comprehension of this. I formulated the following two concrete research objectives:

- *Study how ISs may function as enablers and/or constrainers for social practice taking into account social systems heterogenic characteristics*

- *Study challenges of dealing with ISs that are not supporting the organization*

Sections:

10.1 The HIS as an enabler and constrainer

Research objective 1)

- *Study how ISs may function as enablers and/or constrainers for social practice taking into account social systems heterogenic characteristics*

Walsham (1993) proposes that the role of an IS can be seen as a "modality" between social structures and interaction; enabling and/or constraining structuration processes. Regarding change in social systems, as shown in [2.2.3], Giddens' (1984) model of social change ([2.2.2]) gives the implication that the IS must enable the right type and degree of changes, in addition to being able to follow the momentum of these changes, to be supportive for change in social practice for the target context. In addition, since the social system is not only enabled for change, but more precisely both in the *time* and *locus* dimension, ISs should support variations in social practice in the *time* dimension, but as well in the *locus* dimension at a certain time for not constraining parts of the organization. The issue then becomes how this is done in practice. Hanseth and Monteiro (1997) denoted the social system as an installed base of users, work-practices, technical components, etc. Hanseth (1998) then states that technology needs to be flexible to be able to support an ever changing installed base. Further, the question becomes how to implement flexibility into HISs?

I will look into how the systems included in this study relates to being enabled for change to follow variance and change in social practice; how they are (or not) flexible.

10.1.1 Systems and flexibility

Sisprog

An explicit objective for the design of Sisprog, as the first computerized HIS in Mozambique, was to support the existing organizational routines as much as possible and make it simple to use so staff without much computer literacy could operate it (MISAU, 1994). What was probably not much thought of were the potential variable and changing needs for the organization. Due to design choices in Sisprog there are very few possibilities to do changes directly in the application by the users. To add organizational units is possible in the national version, whereas additional changes, such as which data to collect and how to process, analyse and present them is not supported. According to Heywood (1994) and Lippeveld (2001) typical HIS characteristics are to support collection, processing, analysis and presentation of information. Then, as shown in [2.2.3], social systems may have different needs at different loci and time, which means that to be able to support this the HIS must also be enabled for that, in practice meaning that flexibility regarding different needs for content, process, analysis and presentation in these dimensions must be supported. An implication of this regarding Sisprog is that since it is not possible to do these changes without alteration of the source code, it needs technical support structures around it. However, the developer(s) left after the installation of the application was done and did not train anyone about the technical details of the system. In addition, seemingly little effort was done to keep the source code available, as it soon was lost in a non-functioning laptop. Sisprog functionality was locked because of poor planning regarding sustainability of the system, and this again means that social practice in interaction with the system regarding HIS related matters became heavily constrained. For the Mozambican health system this lack of possibility to alter Sisprog has become problematic (see [5.2.2]). For instance, the introduction of vitamin A as an activity in the health system (Braa et al., 2001) could not be included into Sisprog because of its rigidity. This means that assessment of e.g. effect would be more difficult to carry out, as the HIS did not support analysis with the variable included.

SIMP

SIMP has embodied several restrictions regarding supporting or enabling change in social practice. No data elements, indicators or other analysis means are possible to alter, add or delete for the users of the system. For instance, all routine data are aggregated into monthly *district* totals in SIMP at import. This means that potential important details are lost in all health programs SIMP is handling before any analysis at all can be done. This is opposing to Obit (1987), who stresses the importance to enable analysis of health data for all levels in the administrative hierarchy. The issue

of aggregated values was not seen as a problem in MISAU as they said that they did not need information that detailed anyway. This indicates that the former changes in the HIS is much due to what MISAU sees as important for them, rather than thinking of the needs from district and below. As SIMP has become an official part of the national HIS, the developer's thoughts about how the system should function is getting more embedded into organizational structures.

However, SIMP still has technical support provided by a consultant in MISAU. For example, between the first and last time I was in Mozambique, support for using a USB memory stick instead of the before forced use of Zip diskettes for transference of data, was added. Though, when investigating the application for the purpose of knowing it better for our development work we found several bugs, e.g. a bug with the implication that under certain circumstances data from the Sisprog tables were not read correctly, and so produced wrong data into SIMP. Health data content-wise nothing was changed. For instance, the data element "Vitamin A" is still not included into the HIS by SIMP. Many years after provision of vitamin A was introduced as a social practice it is still impossible to do any analysis around it, as it is not a part of the HIS tools. Health workers also said that the analysis possibilities of SIMP were unsatisfactory, as no graphs are possible to produce. These matters indicate that technical issues regarding, for instance, supporting new technology might be seen as more important than to support actual needs for health information among the real users. It also means that the rigidity of SIMP already is a potential big problem for the organization since the support network, which is maybe especially important when the software itself is not enabled for change by the users, is not working properly either.

Modulo Basico

Due to the design of the Modulo Basico there are very few possibilities to do changes directly in the application by the users. This is done intentionally (see [5.2.2]). To add organizational units is possible. In regards to which data to enter into the system and how to process it (for instance calculation of indicators) is not possible to alter for the users. However, there are some possibilities to customize analysis and reports by having enabled the possibility for the users to decide length of period aggregation in reports, but for instance, the choice of which data elements or indicators to analyze together is highly constrained for the users. It is only possible to combine data elements or indicators made from one and one specific paper form, as both data entry and report generation in general follow strictly the paper form structures. If there is a need for change, it must be done by changing the source code: it needs technical support structures around it.

The software is still supported by the developer as he is working for MISAU. He told me that the need for a computer programmer to change the system was not a problem, as he could provide any change necessary. However, for instance, in 2005, it was reported by users that some data elements formerly entered into Sisprog was missing in the Modulo Basico. The procedure for fixing this was then that it had to be reported to the Ministry, and he had to get to know it. Then he had to do changes in the source code of the application. Subsequently the application had to be sent back to the provinces and their districts, installed again, and then the users could use it as they

wished upon. This is a bothersome procedure which may compromise the momentum of social change for the organization. In addition, if several requests like this appear at a regular basis, as needs for some other data to collect, other types of analysis etc. may occur, it is unlikely that one person centrally situated could support all this. This also means that by not having any inherent flexibility in the system, having a support network is as well likely to not be 100% appropriate for ever changing demands and needs in the heterogeneous social system of the health care organization.

DHIS

The DHIS software is designed especially to be flexible for the users acknowledging that there are different needs at different places and time in the organization.

However, not only inflexible ISs need technical support structures to survive. I will use the DHIS software and global HISP efforts as an example of importance of sustained support, even for assumed flexible systems. The DHIS software was intentionally meant to support the South African HIS by being flexible to certain types of organizational needs (data elements to collect and flexible analysis), needs which were as well backed up by research in the same domain (see [2.1.3]; Braa and Hedberg, 2002). Emphasis on supporting the users' needs made the survival of the software more likely, as the structural intention of the developers inscribed into the software and the reality of the context itself were well aligned and assured further alignment through sustained support.

As the software has been spread to other countries and over time in single countries, new requirements have arisen. A problem in Mozambique was that the original software was not in Portuguese. By still supporting the software and its users the developers in South Africa managed to include flexible language support by making it multilingual, hence easier implementation of other languages. As seen in [7.1], the momentum of change was severely hampered by the original, rigid language solution. Later, new requirements for the software from central stakeholders in Mozambique emerged (customized data entry user interface) which the current version of the DHIS could not support. As we, the local development team, did not have sufficient resources to support the requirements and at the same time maintaining other important functionality (as flexibility in content), the localized version of DHIS got legacy systems properties. Though, the development team in South Africa still supported the software. Solutions to the problematic issues of the customized Mozambican DHIS were provided by including a flexible customized data entry designer in the next version of the DHIS (v.1.4), again opening up flexibility in the system.

At yet another level, stemming from high level politics and global tendencies, the DHIS has again proven to have its shortcomings. A trend in many countries is to secede from dependency of proprietary ICT solutions. For instance, other operating systems provided for free are often seen as more appropriate than expensive proprietary counterparts. In India a requirement of not using Microsoft based products have given many consequences for HISP and the DHIS software. As the first versions of DHIS were made to support only a MS Windows environment with MS Access

database, they could not be used in these contexts with new requirements. Another redevelopment had to be initiated.

These are all factors which were not thought of when the original DHIS was developed. This means that even if a system is highly flexible, one must always ask and answer: flexible in regards of what? As seen, the answers are often difficult to predict because of the unpredictability of social systems, hence a support network is needed.

Summary

For the IS to function as an enabler for the social system, meaning that it supports change and variation regarding social practice in the time and locus dimensions, two types of practical implementation of flexibility in the systems must be present:

1) Flexibility by not changing the source code; typically something users may make direct use of.
2) Flexibility regarding enabling change of source code; appropriate support structures for technical issues. It was demonstrated that this is necessary even for presumed flexible solutions, as the trajectory, type and momentum of social systems change is according to Giddens (1984) very hard to predict because of human agency and unintended consequences of social practice.

However, it is imaginable that another important factor regarding a systems flexibility in practice is the users knowledge about the system. For instance, if the DHIS application had been used in the Mozambican HIS and if the users did not know how to modify the system, it would in reality function as a system as rigid as Sisprog.

10.1.2 The Legacy systems perspective

I will in this section discuss how the issues mentioned above relate to legacy systems theory (Bisbal et al., 1999; Tromp and Hoffman, 2003; Ulrich, 2002; Robertson, 1997).

The legacy systems Sisprog and SIMP

By not enable change in social practice in the time or locus dimension Sisprog has functioned as a constraint for this in the organization. This is more or less exactly how Bisbal et al. (1999) define legacy systems, however a bit more general; as a system that significantly resists modification and evolution. Sisprog as being a legacy system also complies much with the definition given by Tromp and Hoffman (2003), being a system which was installed in a different setting than that of the current ICT strategy. It suits as well typical properties of legacy systems identified in the literature (Bisbal et al., 1999; Ulrich, 2002; Robertson, 1997):

- Often run on obsolete hardware that is slow and hard to maintain. The province version of Sisprog only functions on computers with Intel Pentium II processors or older.
- Expensive software maintenance because of lack of documentation and knowledge about system details. No source code or other functionality overview is available in Sisprog.
- Integration to other systems is difficult due to lack of clean interfaces. No standardized import or export functionality exists. For instance a problem if graphs made by the application are wanted used in a report; not possible to export to outside the application.
- Difficult or impossible to extend. As there is no source code available it is not possible to do any changes in the application
- Old. Sisprog was made in 1992 and the developers are long gone.

However, unlike Sisprog, the source code of SIMP is still available, there are no hardware compatibility issues, the application is not old, and it is still supported by MISAU; as something which still should be used, meaning that it can not be said to be a system very different than what the current ICT strategy proclaims. This somehow goes against how Tromp and Hoffman (2003) define legacy systems, and regarding typical characteristics of legacy systems mentioned in some legacy systems literature.

Nevertheless, similar to Sisprog it has shown to not enable change in social practice in the time or locus dimension, and hence functions as a constraint to evolvement of social practice in the organization, which complies much with the definition of Bisbal et al. (1999). Because of its expanded area of use and that it is still relatively new, the potential problems of resisting change in social practice are probably still less pronounced, however already noticed at some locations, where other needs than what the national, rigid, standard can offer, as seen above.

Lack of flexibility for the locus dimension (by not having flexibility for users nor appropriate support) may also indicate that both Sisprog and SIMP actually have been functioning as legacy systems for parts of the organization from their very beginning. There have probably always been gaps between the embedded social practice support in the systems and the reality itself. However, existence of heterogeneity of social systems indicates that even if a system does not support social practice in some parts of the organization it may support other parts. For instance, SIMP was seen by MISAU as a well-functioning system enabling and supporting their needs ([5.2.2]), even though at lower levels it functioned as a legacy system being a constraining factor for social practice ([ibid.]).

Differences in legacy systems theories

Legacy systems theory does in general not look much into aspects surrounding emergence of legacy systems, but rather deals with how to cope with them when appeared. This may be unfortunate, as by not explicitly investigate reasons behind the origin of the problems, might give less chance to actually solve the problems when designing and developing extensions, or new systems, and eventually replacing old systems.

However, by looking at how legacy systems are defined by legacy systems theory it is possible to identify clues for aspects which typically give systems their legacy properties. The definitions of Bisbal et al. (1999) and Tromp and Hoffman (2002) regarding what a legacy system is, clearly are different. Tromp and Hoffman (2002) have a context conditioned definition by saying something about whether the system is currently supporting the organization or not. However, Bisbal et al. (1999) give a general definition of it; that if a system resist change, it will sooner or later function as a constraint for social practice since social systems are enabled for change.

The two descriptions are complementary, meaning that leaving out considering one of them only may cause that important parts are missed. Acknowledging both definitions contributions to the problem area, is necessary to understand the whole legacy system problem. For instance, the definition of Bisbal et al. (1999) can tell much about the destiny of a system if it does not inhabit enabling properties. Even if SIMP is currently supported by the IT strategy of MISAU, it is not able to support variation and/or change in social practice, meaning it has problematic properties which will cause trouble for the organization eventually. However, the DHIS software does indeed enable change, indicating that it is not a legacy system according to Bisbal et al. (1999). Nevertheless, due to general characteristics of social systems being heterogeneous and enabled for change, concrete contextual circumstances and difficulty to predict social systems one has to look into matters related to the real target context as well. As seen, the DHIS software in its original format is flexible in many ways, but for instance not in some ways seen as crucial for the Mozambican health system, then differing from the current IT strategy of MISAU.

Summary

Different legacy theorists look upon legacy systems differently. It was shown that these distinctions are complementary, as problems in systems supportiveness are both conditioned by general properties of the systems and as well by specific requirements for the specific target context in where they are operating. The characteristics of an IS being “enabling” (Bisbal et al., 1999) should mean enabling in relation with, and for the specific target context:

- Variation and/or change in both locus and time dimensions.
- Supported through flexibility for users and by having a technical support team.

I will in the next section discuss how so far mentioned issues relate with how HISs and their implementation may be conceptualized as successes or failures in regards to discussions by Heeks et al. (1999).

10.1.3 Success and failure conceptions for HISs

Legacy systems are systems which to a lesser extent manage to support their contexts needs. As the needs have a tendency to be altered; (wish for) organizational change, gaps between enabled and supported use and needs for actual use in the system makes

it to become less appropriate for the target context. The system has then failed, at least partially, according to Heeks et al. (1999). How does success and failure conceptions of Heeks et al. (1999) relate to legacy systems challenges, drawn from the discussion above, which become visible as time passes, or at different loci in an organization?

A typical issue for the Mozambican health context is that systems which are in use have, to a certain extent, supported the organization when they were introduced. They have at least supported the stated central needs. However, as time has passed and/or at different places in the organization organizational needs have changed. The systems are not able to support other requirements. This means that they have been partially failing. A typical issue in the discussions of Heeks et al. (1999) is that emphasis is much on preparing the IS for implementation and immediate alignment between system and social practice. For instance, participatory design prior to implementation is mentioned as an appropriate gap-closing technique. Several other techniques are as well mentioned. However, issues not explicitly discussed and taken into consideration are how the IS may continue to evolve with social practice in the organization after initial implementation and possible success:

- How to keep the gaps small taking into consideration that the social system's needs may vary at different locales (see [2.2.3])
- How to maintain the gaps small over time, as the organization evolves (ibid.)

Seen from the discussion above, user flexibility (not to be confused with use-flexibility in Hanseth and Monteiro (1997)) in technical systems, and support structures for maintaining flexibility are crucial for the survival of an IS, and hence may be strong techniques for keeping gaps small in the way of managing to get the system to follow changes in social practice.

These issues generate some consequences for the meaning of "success" and "failure" terms regarding ISs. Heeks et al. (1999) comment about it themselves saying that a problematic issue is that it is easier to obtain success in implementation when reality – conception of reality gaps are relatively small, which then in most cases mean small changes to current status. The new IS should typically be (tried) implemented with the intention to improve something (Heeks et al., 1999).

If the new IS does not change/improve anything noticeably, can it be said to be successful, even if it is successfully installed and used? For instance, installation of the Modulo Basico was initiated in three pilot provinces in Mozambique already in 2005. When I stayed in Mozambique in December 2006, I was told by MISAU staff that it was soon going to be installed nation-wide. In email conversations with the developer of Modulo Basico I got proofs of the systems "success" in the form as stamped reports from pilot districts received at province offices.

One can say that the installation and use of the software have become a success. However, the HISA approach and software do not support the organizational objectives at all ([5.4] and [0]). In addition, the causes behind what created the old legacy systems (see above) are not addressed, meaning that the software system itself is functioning as a legacy system. It is as rigid as the Sisprog application, and it is not enabling or supporting to the real needs of the context (like flexible analysis and

collection of data). Training of health management is seen as unimportant. The problem with poor data quality ([5.3]) is not addressed in any way ([0]), neither are problems with feedback routines for better health management ([ibid.]). The only solved problem, however not to be neglected, is the former dependency of old computers. But still, for health management, and potential implications in time-space, nothing is improved.

In a similar vein, an important question is "success" or "failure" for whom? For instance, SIMP was seen as a supportive system for MISAU, but for other levels in the HIS hierarchy it functioned as a technical legacy system. This gives consequences for where to look when doing research around this. A consequence of Structuration Theory is, because of the complexity of social systems, that generalizations about social phenomena are temporally and spatially bounded. This means that several parts of the organization need to be investigated. For instance, if I had only looked at how SIMP was used in MISAU, its problematic aspects for other parts of the organization could have passed undiscovered.

Summary

To get an even fuller picture of success and failure factors than Heeks et al. (1999) present, it is imperative to investigate how the technical systems relate to social structures and vice versa over time and loci in an organization. However, the concepts of "success" and "failure" might be much in the eye of the beholder, so being a relatively subjective measurement. Although a system may support some parts of the organization, or in some ways, it may not support other parts, giving a harder time defining what success and failure mean, as success and failure for whom must be considered.

10.2 Dealing with unsupportive ISs

Research objective 2)

- *Study challenges of dealing with ISs that are not supporting the organization*

In this section I will discuss how problematic issues regarding the existing HISs in the Mozambican health sector have been dealt with. Bisbal et al. (1999) categorize mainly three different strategies for dealing with legacy systems; redevelopment, wrapping and migration. I will relate the discussions to this, but also emphasizing other findings which were found to be of importance in these processes, not necessarily directly connected to which specific strategy (as presented by Bisbal et al., 1999) that has been applied. The first subsection is about how typical problems with systems in regards of the organizational surroundings have been handled. In the two next subsections HISP efforts regarding IS development and implementation will be followed in more detail. A wrap-up of the whole section will be provided in the last subsection.

10.2.1 Strategies and plans for solving IS problems

I will here discuss how problematic issues of the HISs in Mozambique have been handled.

Modularization processes and fragmentation

Braa et al. (2007) state that standards need to be flexible to be able to sustain their supportive characteristics for an ever changing social system. A way of being flexible is so-called change flexibility (Hanseth and Monteiro, 1997). This means that the standard itself is changeable. As opposed to integration into a standard, Braa et al. (2007) suggest implementation of change-flexibility (modularization) to keep standards simple. Gateways are then suggested to be used to connect incompatible standards.

A problematic issue in many of the technical solutions in the Mozambican HIS is that in their design it is probably not thought of the possible appropriateness of having communicable systems. Typically, when new health programs or new collected data have been computerized, modularization strategies have been applied. For instance, an own computer application was made for the health program BES, collection and reporting of epidemiological data. A potential problem is that it was made independently of the already existing Sisprog, as no gateway was made between them. This means that combining information from the two programs is impossible by default. Having in mind that one of the applications is handling vaccination data and the other one is handling outbreaks of diseases, it is imaginable that for instance, monitoring quality of vaccination (also considering the poor data quality regarding this health program, see [6.4]) integrated analysis would have been appropriate.

Another example is Sisprog itself. It takes care of computerization, reporting and analysis of several health programs. However, there are no internal gateways between information from different health programs in the application. For instance, Sisprog handles EPI and the Mother-Child health programs. In [6.4] the appropriateness of analyzing data from the two health programs together was shown. However, this is not possible in Sisprog, as analysis only follows separate health programs. Because of no implemented flexibility in Sisprog, see previous sections, this has not been possible to solve.

One sees from the two examples above that modularization is dependent on gateways to avoid informational fragmentation. Fragmentation, meaning incompatible standards without any gateway solutions, has become a problem in the Mozambican HIS as gateway solutions often have been absent. Fragmented efforts in development and implementation (see [5.2.3]); often donor-driven (see [5.2.2] and [5.2.3]), and less thought of solutions regarding enabling social practice have created these problematic issues.

Dealing with fragmentation and Sisprog: SIMP

Due to emerging problems of fragmentation of the HIS, lack of standardized procedures for budget planning, and Sisprogs inability to enable other social practice than the centralized embedded practice of 1992, an effort to counter all this was done by developing SIMP ([5.2.2]). With SIMP, the organization got a computerized HIS which managed to "*cobrir lacunas*"[11], as the SIMP developer told, as to solve the immediate problematic issues of Sisprog by having implemented possibilities to enter the data not possible to enter into Sisprog for health programs encompassed by Sisprog. The stated organizational needs were again supported by the computerized tools of the HIS.

However, SIMP is still dependent on Sisprog to be able to cover its whole application area[12], because the only way to get Sisprog data into SIMP is importing them from Sisprog itself. It is impossible to introduce Sisprog data directly into SIMP. This means that SIMP and Sisprog are in practice functioning as one system, with Sisprog as one of the data entry interfaces of SIMP. This strategy for dealing with a legacy system is by Bisbal et al. (1999) called wrapping. It is seen as a relatively high risk solution because the legacy systems problem of the old system will probably not be solved. The SIMP/Sisprog case demonstrates that very well:

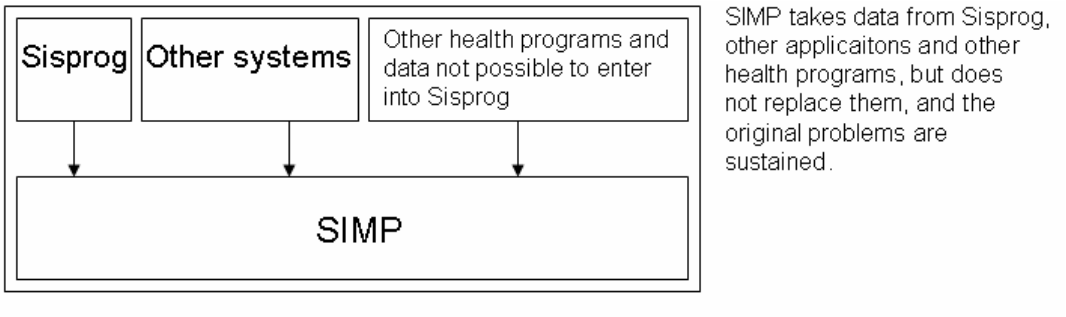


Figure 28: SIMP still dependent on Sisprog to be fully functional

The problems of Sisprog are dragged along with the introduction of the new system. For instance, the hardware compatibility problem of Sisprog was then not solved by introducing SIMP. To minimize the risk of loosing much information if the old computer stops functioning and because of availability of newer computers, SIMP is running on these newer, but Sisprog is still running at the old ones. In addition, because of the rigidity in Sisprog, new data elements for the health programs Sisprog should handle have to be entered manually into SIMP. This creates a bothersome routine, since data from the same paper forms have to be entered into two different applications at two different computers. A better solution would probably be to have the possibility to enter the data from the health programs encompassed by Sisprog directly into SIMP instead. Then Sisprog would be redundant. A question then

[11] Portuguese expression which means "to complement something". In this context it means "Filling in for informational "holes" in the general HIS".
[12] Actually, as SIMP handles much other data than those from Sisprog, SIMP could still be supportive for parts of the organization without the data from Sisprog. However, that does not mean that Sisprog data are unimportant.

becomes why this was not implemented from the very beginning by the SIMP developer. By looking at how SIMP was developed and with which support it becomes more understandable. The SIMP project originated by initiative from the developer himself, and he was piloting the system in one province ([5.2.2]). Initially the system was not part of the official routines in the HIS, and to not disturb the national standards, which are driven by MISAU, Sisprog could then not be removed as it was one of the main computerized HISs while SIMP development was going on. In addition, Sisprog was probably relatively well known by health management, meaning that continuing entering data into Sisprog instead of changing routines would create less resistance in pilot phases. However, as seen, SIMP itself is functioning as a legacy system for parts of the organization. This means that even though the strategy of resolving the Sisprog challenges were tackled inappropriately, SIMP is problematic as well independently of Sisprog. One sees here that SIMP embed the same problematic properties as Sisprog, hence it is obvious that the developers of and stakeholders around SIMP did not take into consideration a main concern regarding Sisprog; its failure regarding supportiveness for change and variation in social practice. Immediate centrally decided needs are covered, but opening up the HIS for change and variation is still not supported in SIMP.

Plans for replacement of Sisprog and SIMP

According to the official objectives made by MISAU (PDSIS, 2003), Sisprog was going to be replaced by a localized version of DHIS, and later SIMP should be replaced as well ([5.4]):

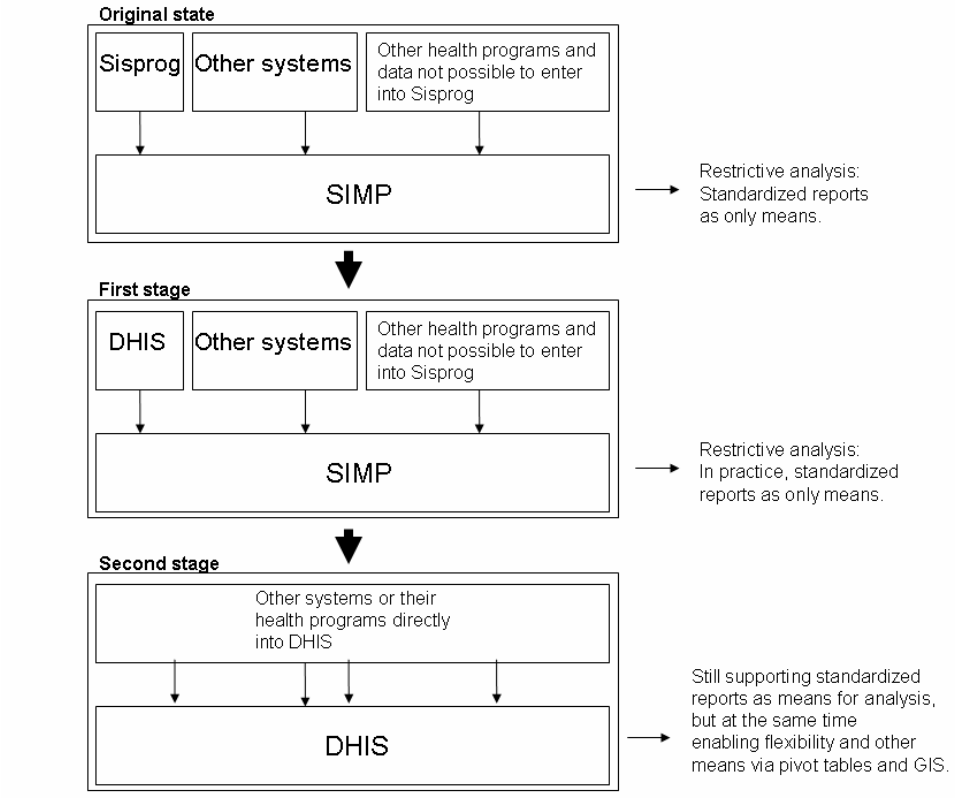


Figure 29: The two stages of Sisprog and SIMP replacement

In both stages typical migration strategies would be applied (Bisbal et al., 1999) to get rid of the legacy systems. The replacement of Sisprog should intentionally improve the supportiveness to social practice of the whole HIS because of the inbuilt flexibility of DHIS. However, there is an inherent constraint in the strategy of gradually replace the legacy systems. At that time (2004) the main purpose of Sisprog was to feed SIMP with data. Since SIMP was not going to be replaced immediately, DHIS would then more or less only fill the limited role of Sisprog, and not adding much new to the HIS, at least at province level. By only being the new data feeder of SIMP, SIMP would then continue to be the main analysis tool. Having in mind the restrictive functionality of SIMP ([5.2.2]), it means that already in the plans for organizational development, a delay in resolving the legacy problems was realized. Getting rid of the legacy systems problems would then be truly realized only when the replacement of SIMP had succeeded. Bisbal et al. (1999) mention how database population may be a problem because of structural differences between the systems when changing *from* the *old* to the new. However, in our case, because of the requirements from MISAU, we actually had to use resources to work on a solution which could move data *from* the *new* system to the legacy system. Although technical challenges regarding for instance database mapping are the similar when moving data between databases with different structures, it could be said to be a relatively conservative strategy for solving legacy systems problems.

After the localization processes of DHIS were done, it had obtained many problematic properties; many of them which much resemble the problematic properties of Sisprog and SIMP. The customized data entry user interface is as rigid as Sisprog itself, as it needs a computer programmer for alterations. It functions as a layer on top of the DHIS core module, and hence hinders the advantageous flexibility built in DHIS. In addition, the final compilation made by the Mozambican HISP team did not enable the modules to be “integrated” into the DHIS core module user interface, which may weaken inscriptions for using the rest of the DHIS apart from the customized modules. This became evident in Inhambane, where they, after encountering problems with the customized modules, did not take any part of the DHIS into use (see [7.3.2]).

Due to disagreements in a meeting in MISAU in 2004 (see [8.2]), the Modulo Basico was as well decided to be piloted. As it became, piloting of the Modulo Basico was initiated in 2005, even though it had not been included in any official plans made in MISAU:

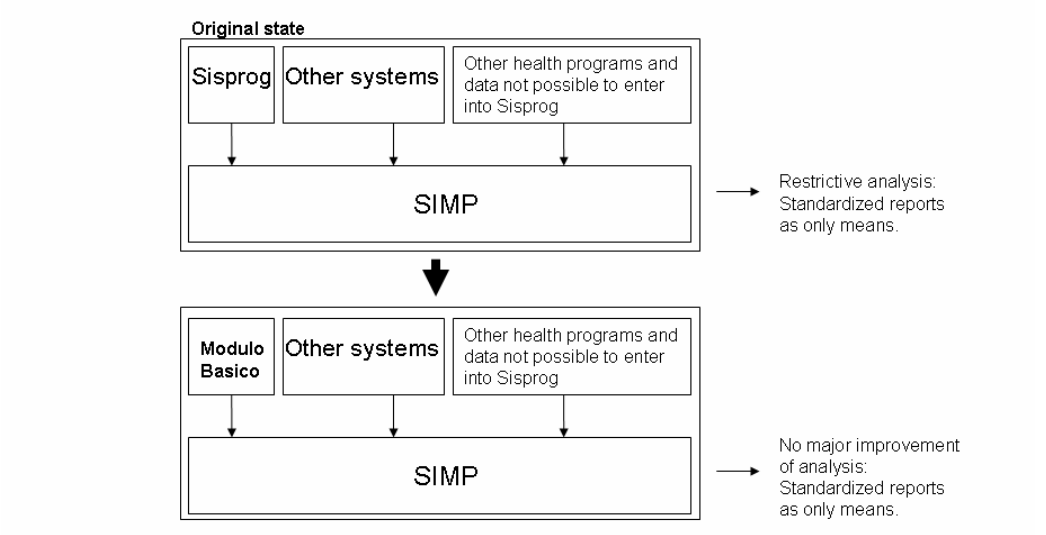


Figure 30: The Modulo Basico replacing Sisprog

The initial plan was to replace Sisprog. According to Bisbal et al. (1999) this strategy represents a redevelopment strategy at component level, however, as with the other solutions, a migration strategy. A problem with the solution in the specific case of the Modulo Basico is that although it represents an improvement regarding hardware compatibility over Sisprog, it embeds the same restrictions regarding flexibility and functionality, which is problematic. Eventually the Modulo Basico was included into organizational plans, and MISAU created in 2005 the following suggestion to how different HISs should operate in the Mozambican health system:

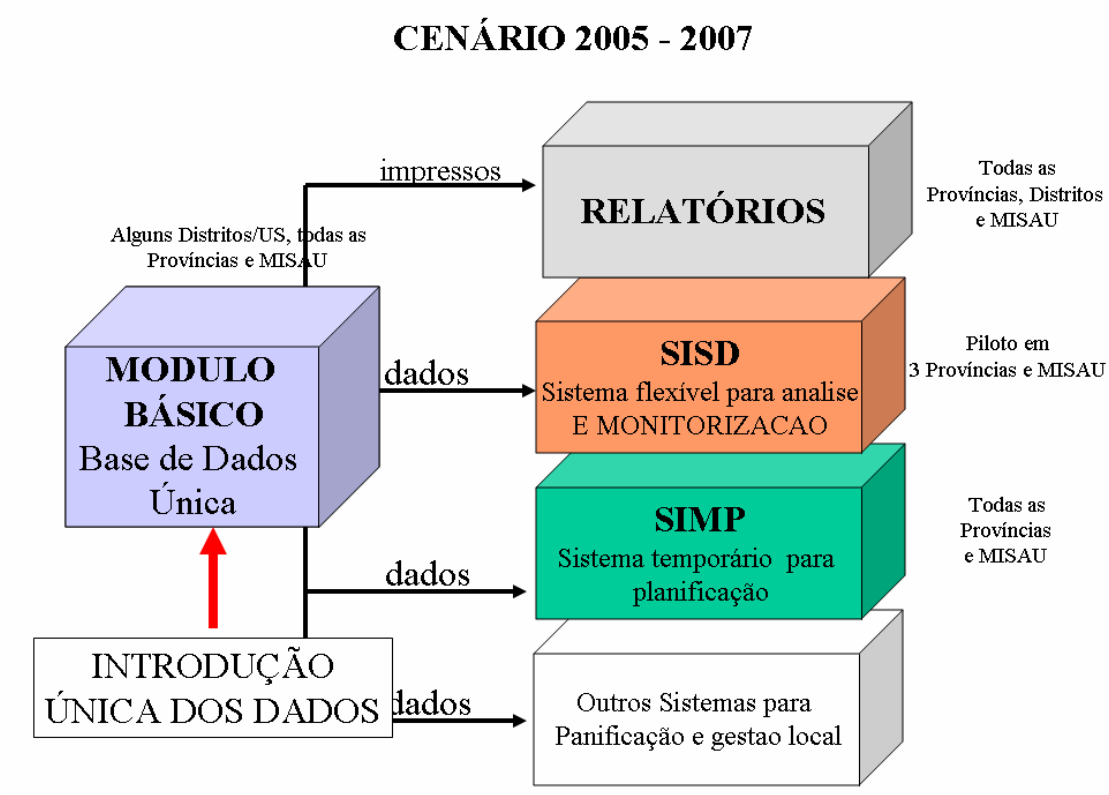


Figure 31: MISAU plans for computerized HISs as of 2005 (MISAU, 2005). [13]

[13] "Relatorios" is Portuguese for reports; "dados" means data; "SISD" means DHIS

This scenario inhabits several problematic issues indicating that stakeholders in MISAU may struggle to identify challenges in the HIS. For instance, it is proposed that introduction of data should only be into the Modulo Basico. There are at least two unfortunate issues regarding this:

1. There are no data validation possibilities in the Modulo Basico, which means that data quality check can not be done at data entry level. This might be a problem; in the Mozambican context specifically, as data quality is in general low (see [5.3]). DHIS and SIMP have data validation, but the procedure for data validation will be sub-optimal when data have to travel far before validated. Extra time and resources will have to be used for this procedure.
2. The Modulo Basico has problems with flexibility. It can in practice only support the national standard of data (if even that in an appropriate manner, see [10.1]). If the system is the only one for computerization of data, it so locks the organization in regards of which data to collect. Possible local differences in needs (as seen in [5.2.2]) will then not be supported by the national HIS.

Summary

Many efforts to deal with legacy systems in the Mozambican HIS have encountered problems. Several of the strategies, as presented by Bisbal et al. (1999), for how to deal with the systems have been applied, however, so far with only moderate success. Typically, the same problematic issues seem to reappear independently of which strategy that has been chosen. Efforts for improvement have lead to that new systems represent small changes only, with poor enablement for later organizational changes, or sensitivity for local needs.

To understand the above mentioned problems better I will in the following two subsections go more into details around *processes* where legacy systems problems in the Mozambican health context have been dealt with. I will look into HISP/MISAU processes regarding systems design, development and implementation. I took part in several of these activities which gave me the chance to study the processes from the inside; opening up the “black box”. I will concentrate mainly on three aspects; power relations and holders of power; (potential) users; and the action research project HISP. There are relations between these, and how these have been influenced and influencing each other will be discussed. It will be set in the light of a developing country’s context.

10.2.2 HISP software design and development processes

I will in this section discuss design and development processes I participated in regarding customizing the DHIS software for the Mozambican health context. The processes were challenged and influenced by diverse social structures. The discussion will be done in regards to the attempt to counter the legacy systems problems in the organization.

MISAU involvement in systems design and development

Although a main objective was to improve the HIS, different actors had different opinions and comprehension of what improvement meant. In addition, actors' differences in transformative capacity had much influence on the design processes, as contrasting opinions then had different impact. The processes were as well clearly influenced by general norms in MISAU and by central stakeholders, processes which, as seen with former HISP efforts, often materialized into status quo, or only small changes.

Power relations

Until the beginning of 2004 HISP in Mozambique had functioned as a pilot project. The acknowledgement of the HISP approach and the DHIS software as the reference of the future HIS of Mozambique seemingly clearly indicated that HISP by 2004 had made substantial impact on social structures of MISAU. The structural intensions of the HISP philosophy seemed to have become an embedded part of MISAU rendered visible through the official plans. However, including the HISP approach and software into being an official part of the HIS also represented a shift in ownership and control of processes. Earlier, HISP had steered development and customization processes relatively freely, but now MISAU had become the main responsible. MISAU consultants had their views on how the DHIS should be customized for the Mozambican health system. Internal changes in MISAU would in the end as well make a large impact. An EC consultant who had arrived had strong opinions regarding how things should be, often contradicting the official plans and hence disagreeing with HISP as well.

The HISP team in Mozambique during the time of negotiations was mainly a group of master students, I included. It soon became clear that we did not have much power in MISAU. This is maybe not very strange taking into account our status as students. Another issue, probably unfortunate, was that the HISP team misinterpreted the transformative capacity of the newly arrived EC consultant. Among HISP members the attitude was to not take the one-man initiative very seriously, as in addition, the HISP project had become a part of the official MISAU plans. As well, decisions in initial meetings were made much in compliance with the official plans and hence to a great extent aligned with HISP thoughts. However, as Giddens (1984) states; social structures only exist through interaction (see [2.2.2]). This means that plans can not be taken for granted as being "a part" of the social system (meaning organization) unless they make any actual impact on social practice, as for instance materializing into some sort of processes. This aspect was maybe misjudged by the HISP group.

When the EC consultant chose not to follow what was decided and agreed upon in the meeting with the Director of the department (see [8.2]) it did not produce any consequences or reactions internally in MISAU. The HISP group disagreed with his new decisions, however, as it appeared, we had no power to do anything about it, clearly indicating the differences in transformative capacity. He started instead to focus on customizing his own software, which eventually was granted piloting as an outcome of discussions in a later meeting ([8.2]).

As it became, the EC consultant did not only influence the HISP project and the DHIS software substantially, but he also managed to get his own project piloted. If the EC consultant had been taken seriously, applying means to counter situations which emerged could maybe have given another outcome. For instance, at one point he offered to move to another department, but nothing was done by HISP to pursue this. It is possible to see from this that the power relations between HISP and MISAU, and in MISAU internally, had changed much because of the entrance of the EC consultant. Although he did not have any "official power", his transformative capacity was substantial. The supposedly strong inscription represented by the official plans did not manage to back up the interests of the HISP approach. It is clear that the actual interaction is what one has to relate to.

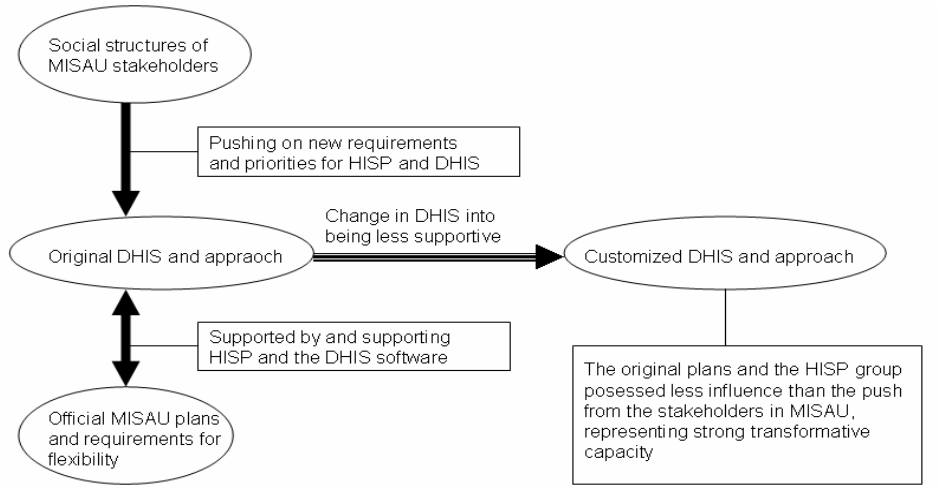


Figure 32: Differences in transformative capacity among actors influenced the outcome.

Different perspectives among actors in design processes

Since MISAU had acknowledged the less fortunate functioning of their current HIS we originally believed that wishes regarding design of software should be much aligned with this. However, decision makers in MISAU seemed to have other priorities than what the HISP group saw as optimal, also to a certain extent contradicting the original priorities in the official plans. For instance, it had become more important to have a specially designed data entry user interface and standardized reports, which compromised the important flexibility of the DHIS system, than keeping its supportive characteristics. These priorities clearly showed the difference in interpretative schemes among the different actors. For instance, the EC consultant saw it as most important to change social practice as little as possible by implementing routines into the systems which supported more or less only current ones, while HISP had an explicit agenda, in the longer run, to reform organizational routines extensively. This is not necessarily contradictory, if the consequences of possible change in social systems is taken into consideration in the HIS design and approach even though only small changes are introduced initially. However, as discussed in [10.1.1] the approach should then include flexible software, and probably also a support network for the software. The HISA approach (of the EC consultant) did not have this embedded, but the original HISP approach and software did. What then mattered much regarding the outcome was the balance in transformative capacity between the actors, which, as seen above, did not favour HISP.

Design choices drifted away from issues originally seen as important ([5.4]), and became more a matter of personal taste and opinions ([8.2]) rather than based on more thoroughly research in the HIS field ([2.1] and [4.1]) or actual experienced problems with existing old systems ([5.2.2] and [10.1.1]). For instance, problems ([5.2.2] and [5.2.3]) caused by current systems as not being able to include or change data to be collected were apparently forgotten:

> *"The flexibility and the supposed periodic variation of regular, routine collection of data is frankly a myth without practice."*[14] *(MISAU consultant, 2005)*

In the DHIS software itself many years of gained understanding about HISs and their needs had been implemented by its developers. However, because of the limited power we possessed in negotiation processes we had problems defending what was seen as the strengths of the DHIS software and HISP approach. So, what then happened was that the new system was customized and designed into being very similar to the old Sisprog, both in terms of functionality and flexibility. To be able to survive as a further alternative HISP and the DHIS software had to, in the end, align to the conservative interpretations by the actors possessing strong transformative capacity, rather than the other way around.

Resistance against change

Even though the objectives for the organization and its HIS were relatively clear ([5.4]), the design and development process were not much directed by them. This might stem from lack of knowledge among decision makers regarding HISs in general, and consequences on social practice originating from constraints in design ([5.3]). It also seemed like a norm was not to risk much in decision making processes. Propositions which meant noticeable change in any direction were mostly not agreed upon ([8.2]); a tendency in MISAU as long as the HISP project has been in Mozambique ([7.1] and [8.1]). I was told by a HISP member that what seemed to be a common political strategy was to always be open for new solutions, but in the end not sign any "final agreements". In that way no one risked having their name connected to a project which might fail; "*if you don't do anything, it's not done wrongly*." Then, by keeping alternatives open at the same time, interest for that something should be done for improvement was shown. When aiming at improving something, it is implicit that something has to change, not only being "open" for change, illustrating the conflict between norms among stakeholders and plans.

Another issue is that it seems like immediate needs and results are getting higher priority than having long term solutions. This seems to be a reoccurring challenge in the Mozambican health system. For instance, SIMP covered many immediate contemporary needs when it was introduced, but developers did not prioritize making something else than a temporary system. The same problem is embedded in the solutions we and the EC consultant made; they may support what is needed right now, but by not taking into consideration probable longer term consequences of not

[14] One year later more than 30 new data elements were included into the paper HIS without the possibility to reflect it in the computer systems ([XX])

enabling change in social practice, the design decisions set survival of the system at risk, and only temporarily postpone problems.

A reason for the reluctance for changes in the specific case of Mozambique might be that in MISAU SIMP was still seen as an adequate system. Their needs were supported. However, by not communicating with users at other levels, seeing that it might not support needs of the organization everywhere failed to be discovered in MISAU.

Lack of communication with and involvement of users

In RHINO (2002) it was stated as crucial to involve key stakeholders in design of HISs. Acknowledging the social systems perspective one also has to acknowledge that the users of the system should be seen as key stakeholders ([2.2.3]). This fits well into common views on participatory design strategies, as according to Kensing and Blomberg (1998) the participation of the intended users in technology design is seen as one of the preconditions of good design. Earlier development processes of the DHIS software in the Mozambican health context had to a certain extent (see [6.1]) been following a variant of participatory design which Kimaro and Titlestad (2005) named participatory customization ([2.3.1]). This approach for design is typically a part of the HISP approach for customizing the DHIS software. By the shift of approach from being "outside" MISAU into becoming a part of the MISAU objectives, design choices became steered from MISAU.

In the design and development processes after the HISP approach became embedded into national plans, communication with real users was absent. Initially, we were not even allowed by MSAU to go to the pilot sites. This probably influenced the design and development as we only could relate to our perceptions about how the situation was (even though we had gotten some clues at a field trip earlier), in addition to MISAU requirements. This could have been unfortunate, as among users, at DPSs and DDSs, there was some understanding about actual needs for their HIS ([5.2.2] and [5.3]). What we typically observed and got to know when interviewing health staff was that, among those with above average knowledge about health information, the shortcomings of the official systems seemed obvious. For instance, at one district office a lady produced graphs from MS Excel on her own initiative because the official systems did not have support for that. Other places we heard about needs to collect other data than what was possible in the official system ([ibid.]). The choices of what was important in design of the new systems (see above) indicate that organizational needs are not well known or taken into consideration among central decision makers, maybe due to scarce communication between the levels in the HIS hierarchy. For instance, normally, the only communication between hierarchical levels (DDS – DPS; DPS - MISAU) was transference of health data upwards, and complaints downwards if something seemed to be wrong ([5.3]). Real needs for the context were less communicated ([5.2.2]).

However, Heeks et al. (1999) claim that user participation strategies in design processes are conditioned by several contextual factors. They list various factors which may disfavour effective and fruitful user participation anyway:

- Users lack information about participative techniques and about the new information system
- Users lack the skills and confidence necessary to engage in participative processes

Earlier experience from HISP design efforts indicates some challenges, similar to those mentioned by Heeks et al. (1999). Before HISP there had never been any initiatives to user participation in design processes of the HISs in Mozambique. However, I was told by a Mozambican HISP member that the participatory aspect of design processes in practice was rather to get knowledge about the existing content of the SIS and include that into the DHIS, than an interchange of knowledge and understanding between the users and designers. In addition, from the course we held in Massinga 2004, it became clear that knowledge of computer use, the DHIS software, and health information use in general, was low, taking into consideration the various training sessions and seminars which were given at earlier stages by other HISP members.

Further, Heeks et al. (1999) say:

- The objectives of senior staff are not to share power and the values of the organization are authoritarian and hierarchical
- The management style and organizational structures of the organization are highly centralized

These power issues were important in our design and development processes. For example, MISAU wanted to control the development and no one should go to any pilot sites to test anything before the software was ready.

Heeks et al. (1999) also mention the following:

- The organization lacks the time and money to invest in participative approaches

As seen in [5] resources are scarce in the Mozambican health care organization, and especially at lower levels the staffs day is usually packed with work. Mosse and Sahay (2005) reported time constraints among health workers as a major reason for less participation in HISP training at earlier stages.

Some of these points indicate that the fruitfulness of user involvement might be of lesser value in this case anyway. However, by managing to involve the staffs we met who were among the more knowledgeable, a positive outcome could probably be reached, but with a risk of steering the development into special needs for some few special users. However, an important issue not pointed out by Heeks et al. (1999) is the possible augmentation of users' interests originating from participatory design processes (see [2.3.1]). It is imaginable that, although the users had limited knowledge regarding HISs and maybe limited actual influence, they could have become more interested if they felt that they were involved in the making of the system. For instance, when we were finalizing the customized modules in Inhambane in August 2004, we were warmly welcomed by the potential users when we asked them to test the system.

However, the tradition of Scandinavian approaches of actively trying to change social structures (see [2.3.1]), which to a certain extent had been present in former HISP customization efforts, was more or less abandoned due to the centrally steered design process when I was working there. MISAU, which represented crucial transformative capacity, effectively hindered any noticeable participation.

Prototyping challenges

Regarding the export functionality from DHIS to SIMP it was actually an advantage of being near MISAU. We thought many times that we had a working solution, while new errors appeared seemingly for no obvious reason. By examining all the databases and tables involved we obtained much knowledge about the errors, but at several instances we had to ask the developer of SIMP for assistance. Cunningly enough, at some occasions neither he understood the exact problems. Anyway, real users' participation in development processes would probably not influenced the design of the export application much, as the user interaction with the application was more or less only a push of a button to initiate the export process.

Pape and Thoresen (1986) emphasize the importance of a trial and error process facilitating testing of different solutions to solve potential problems that may arise. A typical advantage of having real users involved in testing of design is also that their patterns of use regarding the software will be tested and better understood. According to Orlikowski (1993), technology is interpretatively flexible. When we finally stayed in Inhambane in August 2004, staffs which were going to use the application tested it. After only 5 minutes of testing they managed to get the customized data entry module to crash. We had been in a hurry when doing the last work, and something was not working. We corrected it, and it should work. However, seemingly not everything worked as it should after all, as when another HISP team member went to Inhambane a couple of months later to check if everything was functioning, the software did not function, and it was not in use. If we had users available for being testers during the development process, errors like that would probably have been caught at an earlier stage.

Technical skills within the Mozambican HISP

Strictly speaking, we could have made a more flexible design of the customizations. However, there were several aspects hindering this. Making a data entry user interface designer for maintaining the flexibility would have required more resources in regards of time, personnel or knowledge than we had because of the complexity involved of making it. In addition, DHIS was already a more or less complete system. Changing a quite complex system with lack of detailed documentation was not easy. A work-around was done: Building external modules which were not well connected to DHIS core functionality. One consequence of this was that the DHIS application did not even have to be initiated for health management to run the customized version.

The Mozambican HISP project has been challenged by lack of technical competence among the team members. Software development locally has been almost absent, and

has given consequences. For instance, already in 2002 a request came from MISAU regarding making a gateway between DHIS and SIMP (MISAU, 2002). However, after an evaluation by the HISP team it was stated to be more or less impossible. Between 2004 and the end of 2006 not much was done regarding technical development of the DHIS software in Mozambique although it still did not work properly regarding the MISAU requirements. Hence, implementation was hindered. This illustrates the importance of having a technical support team available for the IS. Fortunately for HISP in Mozambique it is a part of the broader HISP project. Because of this it has been possible to get a system which functions after the requirements from MISAU in an appropriate manner by maintaining the inbuilt flexibility of the software.

Summary

One of the reasons for why the DHIS software and the HISP approach was included in the plans for the Mozambican health sector was the supportive properties of enabling a flexible environment for a well functioning action driven and evidence based health information culture. However, shaped by structural perceptions among stakeholders in MISAU and a less than optimal development group, the outcome of customization processes was software having many of the same constraints as the current systems. Social structures influencing customization processes of the DHIS software had turned it into being a system with many legacy systems tendencies for the context before even implemented. The main point here is not that we did not have the appropriate resources to develop a good system, however that it was seen as more important by MISAU stakeholders to have a specially designed user interface than having a software and approach which could counter the problematic issues of old software and approaches. This set of priorities also opened up for the HISA approach, as the approach's weaknesses were given less priority than its strengths in supporting the special requirements. The consequence of these priorities is that interaction between the system and social agents in everyday use will face similar challenges as already experienced with the old systems even with the new systems. However, because of a strong support network for DHIS in HISP eventually a flexible system for which should be possible to get political support from MISAU was finished by main developers in South Africa.

10.2.3 HISP implementation processes

I will here discuss HISP implementation and support processes taking place in Mozambique. The discussion will draw on implementation efforts I participated in, but also from former HISP implementation processes.

Objective and outcome so far

The HISP philosophy is quite specific regarding objectives for how HISs should be used in organizational work (see [4.1.3]). Piloting of the project started in three districts in 2000, and in 2002 the Mozambican HISP got permission to do pilot implementation in three provinces. Software could freely be installed, and HISP

could do training of health management etc, without much interference from MISAU. The DHIS software was also installed more or less at every computer available to health management in the pilot sites. However, the field trip to two HISP pilot provinces in March 2004 ([3.2.2]) revealed that the DHIS software was not in use at any location in those two provinces. In addition, from observations and interviews during the field trip ([7.2]) and experiences from the course we held for health management in Inhambane in August 2004, the impact of HISP on social structures of health management in general had been sparse. At present time implementation processes are on hold.

HISP approach to implementation processes

In all processes where social change is an explicit objective, the agents who are involved in change processes need appropriate transformative capacity to make appropriate impact. I will in the discussion have in mind how the relation in transformative capacity between actors have influenced implementation processes, and how actors have dealt with not having the appropriate capacity to control resources as wished upon.

In implementation processes HISP Mozambique had to work on two fronts at the same time. As in South Africa a **bottom-up strategy** was primarily chosen, aiming at building capacity and better comprehension among health management regarding HISs, information use and decision making culture in general. However, at the same time **political support** was needed, so that permission to initiate change processes was ensured. Thus, HISP had as well to negotiate with central power holders. In the case of Mozambique, it is MISAU which has the power to decide how to deal with their HIS. The shape of top-level support has affected the outcome of the bottom-up approach and has had consequences for the implementation of the HISP approach in Mozambique.

MISAU involvement in implementation processes

Problematic support for approach
How the support from MISAU materialized had its difficulties. Although MISAU gave permission for pilot implementation, the distinct difference between giving permission for and require something became a challenge. Health workers did not get permission to quit old routines when the piloting of the HISP project was going on. At district level the paper based system still had to exist in parallel with the DHIS, and when piloting eventually moved to encompass whole provinces, HISP was not allowed to interfere with the current systems and routines around them. The DHIS application and usage of it had to co-exist with the other computer applications Sisprog and SIMP. In addition, new routines pushed by HISP did not get much backing from the power holders, MISAU, as they were not at all required. This means that health workers did not experience any consequences of not aligning to HISP efforts, only if not continuing the current routines. HISP related matters then meant, in practice, more or less double, unnecessary work for health management.

No provision of resources
The budget for HISP was limited, only consisting of funding from NUFU and later from the BEANISH project ([8.1]). In addition, HISP Mozambique *was* the Ph.D. students. They had as well their studies to take care of, and spent much time at the UiO in Norway. The problematic issues were acknowledged by HISP and MISAU, and several plans and budgets aiming at making the efforts more sustained were set up in the ministry (see [8.1]). However, none of the budgets was ever realized. MISAU never provided any resources for implementation. One of the reasons MISAU gave for not providing more support, was the lack of results from HISP. However, HISP meant that more top level support was needed to make any real impact, due to the above mentioned conditions. The dead-lock situation was probably not helped by the emergence of other HIS approaches. The introduction of SIMP made it harder for the HISP project to implement the DHIS "as it was". In addition, SIMP served many needs for MISAU and province level, meaning that HISP and the DHIS software maybe became seen as less important among power holders in MISAU.

Change of ownership of process; change of focus
The shift from being a pilot project into being owned by MISAU gave consequences for the HISP project. New requirements were set, and the processes became much focused on software in itself, and less on the approach as a whole. An issue with this was that "implementation" got the meaning of only installing software, which had caused problems in the organization already (see [10.2.1]).

HISP issues and users involvement in implementation

Coping with limited top-level support
However, even though health management was not required to follow HISP, HISP was initially free to work in the pilot sites. It was believed that with training of health management interest for the approach could be augmented. If it could be possible to make health management see the advantages of the approach as higher than the burden of doing some extra work, it would enhance the chances of managing to change current routines. If then change of routines produced positive results, it would probably give HISP more power in negotiation processes for MISAU support. Though, training of health management did not succeed in regards of changing existing routines in any noticeable manner. The outcome of the training was influenced by a diverse set of factors.

Problems in training of health management
The constitution of the training in itself had some problematic issues. Training usually meant short courses and seminars ([7.1]). In addition, following up health management in real life situations after the seminars almost never happened. This was probably unfortunate, as the existing routines in health management were quite far from what HISP saw as appropriate ([5.3]). Indications from other HISP countries suggest that sustained training over much longer periods is needed to make a real impact. For instance, I was told by Ethiopian HISP employees that not even 6 months of presence and work at pilot sites had been sufficient for reaching their objectives regarding implementation. In South Africa it is estimated that 80% of the budget for HIS development is directed to training of health management (Shaw, 2006). A

potential problem regarding sustained training was the location of the pilot sites. Even though not chosen randomly ([7.1.1]), they were far away from Maputo, where the HISP team members lived. This means that it was more cumbersome to go there, stay for longer periods, and more expensive.

Lack of transformative capacity at lower levels and in HISP
A potential problem regarding creation of interest for the approach (hence organizational change) among lower levels staff may stem from the centralized power distribution. Only MISAU and the province offices have their own budgets (see [5.3]). This means that data quality, and importance of data analysis for better resource distribution might seem not as essential for lower level staff, as they have no direct power to make major changes anyway.

In Inhambane we met much interest for HISP and DHIS among province health management. However, the shift of ownership of the process had lead to that provinces and HISP had less power to drive implementation processes. So, cunningly enough, when it finally had been decided that the HISP approach and DHIS should be a part of the official HIS, implementation efforts were hindered by the ones who gave the approach the official acceptance. We got another opportunity in Inhambane in August 2004. The strategy we formulated with the province management explicitly aimed at counter issues regarding lack of sustained efforts, which had been present and problematic at earlier HISP implementation processes. They had sufficient resources to allocate some for initiating a provincial implementation team which could support the districts. However, at least two things were needed; that someone was going to be trained for being trainers, and as well functioning software. HISP was going to take the responsibility. However, the HISP team only sporadically returned, and the necessary training was not given. In addition, the customized software did not work as required, and it took two years before any version of DHIS customized to the Mozambican requirements was ready. Implementation processes were then hard to initiate.

Social structures meet contextual constraints

Contextual challenges of Mozambique in general, which also influence the health sector in particular, might function as constraints. Mursu et al., (2000 p. 5) list several contextual particularities of developing countries contexts which typically challenge HIS development and implementation efforts. I will relate this to the Mozambican context and how social structures seem to be affected by them:

- Inadequate infrastructure, most noticeably poor power supply and telecommunications.

Lack of general infrastructure as appropriate access to electricity and good roads gives consequences for the routines of the workers in the health sector ([4.2.1]). For instance, the general need for electricity in villages without connection to main power plants is compromising the possibilities to use computers for HISs related matters ([4.2.1]), as power generators serve the population in total, not the health centre specifically. As well, due to poor road quality and poorly developed network of roads

and bridges travelling around to peripheral areas to support implementation activities becomes more difficult.

- Shortage of skilled personnel. There is lack of technical skills and IS professionals and managers educated in managing complex ISD processes. The education emphasizes software engineering instead of information systems development. Thus, "systems developers in Africa work under severe practical constraints but are less adequately trained to cope with them, compared to their colleagues in industrialized countries".

There is severe lack of resources, as appropriately educated staff, as in the society in general ([4.2.1]), which then also means less time for other activities than the normal routines. In MISAU there was typically much focus on software rather than whole approaches where social practice and routines were taken into consideration in implementation processes. As seen, the Mozambican HISP team has always been challenged by the uneven distribution of skills between health related and technical matters.

- Several African countries have grave economic and political problems which cause insecurity of life and uncertainty of future, a formidable hindrance to long-term initiatives like ISD.

Unemployment benefit is not included in the Mozambican social security system. In addition, salaries are in general relatively low, meaning that having more than one job is not uncommon. A challenge for the HISP network in Mozambique has been that many of the HISP team members also have had to take care of other work etc. which then means less time and efforts in implementation processes.

In addition, HISP implementation processes have as well been hindered by priorities among health workers caused by contextual constraints. Not only lack of skilled personnel, as listed by Mursu et al. (2000) is a challenge, but shortage of personnel in general. As seen in [5.3] nurses often do not even have time to register data because of the constant flow of patients. Typically, health management were the same as the ones attending patients at lower levels ([5.3]). Many areas of responsibility had to be covered, in very limited time frames. Patient care was normally a priority area, not HIS learning which did not give any immediate consequences on long queues of patients waiting for attendance.

Technology as power

Another visible problem in Mozambique was limited sharing of technology (typically computers) where it was present. Characteristically, donor funded projects did not share resources with the rest of the SIS even though practical consequences would probably be minimal (see [5.2.2]). This also indicates problems of fragmented strategies, as donor funded projects officially are under the umbrella of MISAU. In a similar vein, something which typically restricted social practice among health workers was that when there were computers present for the SIS itself, they were normally placed in the office of the boss even though it could be more useful other places ([5.3]). As technology is scarce it might become a symbol of power, and people in positions to allocate resource use the technology as a means for reinforcing

the position ([5.3]). This seems to be typical, as other research also indicates similar observations. For instance, Meland (2003) indicated placement of available computers at the office of the bosses as a problematic issue regarding HIS implementation in India, where the issue as well seemed to originate from the ”enhanced power” brought by being in possession of technology.

At the higher political level, it seems like some of the same perceptions may be present. The EuroSys plans hindered for a long time HISP as MISAU became reluctant in giving full support for HISP while the EuroSys initiative was evaluated. EuroSys represented a very ambitious and expensive approach to HISs. However, it still attracted the attention from MISAU for an extended period. In a similar vein, in the beginning of 2007 the Mozambican health minister presented plans for introducing hand-held electronic units for data collection in the HIS. It appears like fancy technology may function as a strong attractor for power holders. A similar experience is mentioned by De Vibe (2005), where a suggestion for a HIS in Cuba kept online by satellite communication attracted power holders. At the same time a common problem, even in Havana, was loss of electricity on a daily basis, making computers hard to use. As HISP typically has a strong focus on the social aspects of HISs, this may be restrictive regarding obtaining support, although the approach is more realistic and aligned to reality.

Summary

As the HISP approach and appropriate use of the DHIS software represented other intentions for social practice than was embedded in the current routines, alignment processes had to be initiated. However, restrictive social structures among main power holders and resistant social structures among health management, together with less than appropriate strategies from HISP, hindered alignment processes to take place. For instance, requirements from MISAU of continuing old routines and at the same time not require any change into new, functioned as strong inscriptions for social structures by much steering social practice of health management to remain unchanged, and made it even harder for the HISP approach with its DHIS software. Also conditioned by challenges in the general Mozambican context and society, reaching alignment in social structures between HISP - MISAU (the main holder of power), HISP – health management and MISAU – health management, has been difficult, and this lack of alignment have given consequences for the outcome.

10.2.4 Dealing with legacy systems in the frame of the social system

The section has revealed many challenges stemming from social structures and conditions regarding the handling of legacy systems problems. I will here summarize important aspects.

Challenges in top-level involvement

A challenge for the Mozambican HISP project has been that development and implementation processes have been "forced" to only introduce no, or only minimal, changes caused by priorities by central stakeholders. Similar experiences have been encountered in similar centralized contexts. For instance, De Vibe (2005) describes, in a case from the Cuban health system, the problem of implementing changes from status quo when not backed up by central power. Design processes are forced into developing something which represents minimal changes, typically with the result of minimal advantage. In Tanzania similar issues are reported, where the Ministry of health looks upon data entry user interface design concurrent to the exiting paper system as crucial for their HISs (Lungo, 2007). As little change as possible when designing something new was a general aim for the EC consultant in MISAU as well. Markus (1983) claims that an IS design with embedded social practice matching the power structures of the target context is more likely to succeed than one requiring changes. This might explain why the HISA approach gained a foothold in MISAU. The approach did not seek any changes other than replacing an old system with a new, similar one. It did not challenge current routines or power structures.

Studying a HIS development project in Cuba, De Vibe (2005) found several aspects regarding importance of top-level involvement for IS projects in centralized settings. Among other things, he concluded with that enrolment of top-level decision makers is crucial in centralized contexts. In addition, from his case, it was shown that without top-level involvement the legacy challenges grow because of the interconnectedness between social and technical structures (De Vibe, 2005).

Seen from the case of Mozambique, power structures are highly centralized, though, not in the same information controlling manner (De Vibe, 2005) as in the Cuban context. As well, it seems like top-level involvement is necessary for managing to make an impact in HIS implementation ([10.2.3]). However, what happened in Mozambique was that even with top-level involvement the legacy challenges were growing. This represents a dilemma; top-level support is needed, but when it arrives, it might not be aligned with the purpose of the project. The way support has materialized for the HISP project in Mozambique is problematic. It is acknowledged that something should be done, but exactly what is less known or processed. This is somehow also reflected in the PDSIS (MISAU, 2003). Problems in the organization are stated, and as well objectives for how it should become. However, what is less described is how to reach there; the process. This seems to open up room for many interpretations regarding optimal routes for organizational development. Focus on software rather than approaches taking into account the whole social system in implementation processes, is an example of how unfortunate views on solutions might materialize when process strategies are originally unclear. Or maybe the technology focus is causing less structured strategies for general organizational development?

This illustrates that not only is top-level support crucial, but in what way this support is given may be even more crucial. If those with power do not act accordingly to the wanted efforts, the processes and outcome may be compromised. The importance of success in alignment processes with crucial power holders can not be underestimated.

HISP in Mozambique has struggled to obtain this in an appropriate way, and the support which has been provided has then become less than optimal.

However, it is imaginable that the issue is not solely about top-level specifically, but the holders of powers in general. In the Cuban and Mozambican health contexts power holders are at top level. In contrast, for instance South Africa functions as a federal state where power is more decentralized, which means more autonomy at peripheral levels. There, negotiation with lower levels than that of the ministry had to be done to obtain appropriate support for the approach. Another issue regarding this is that in the South African case power is closer to the users of the HIS. An important aspect of the success of the HISP approach in South Africa has been that real users of the systems have been much involved in all phases of design and implementation, creating less resistance for use and change (Braa and Hedberg, 2002). This may indicate that, as getting support from power holders is more a general issue than only from top-level, it is also easier to get support from power holders in more decentralized contexts. This is because real needs are probably better known near the real users of the HIS. The case from Inhambane partially confirms this, as there was a lot of interest from province management to take the DHIS software into use, probably because the understanding of the users needs was higher there because of proximity.

Legacy systems as unintended consequences of structuration processes

According to Giddens (1984) social agents draw upon rules and resources in interaction. These rules and resources are constituted by stocks of knowledge, sanctioned by norms, and with their transformative capacity the agents are shaped by, and shaping social structures. Giddens (1984) further states that *"The knowledgeability of human actors is always bounded on the one hand by the unconscious and on the other by unacknowledged conditions/unintended consequences of action"*, Giddens (1984, p. 282). Supported by findings from the Mozambican health context I argue that one may look upon legacy systems typically as unintended consequences of social structures that are materialized through social practice:

Design and development processes
The idea behind introducing a computerized HIS (Sisprog) in the Mozambican health system was indeed clear; to support easier and better analysis and reporting of data (MISAU, 1992; MISAU, 1994). However, as an unintended consequence caused by priorities among stakeholders in design and development processes, the software more or less locked social practice in the organization (see [5.2.2]).

A problem in the Mozambican health care organization has been that when trying to resolve current legacy systems challenges, typically only *immediate needs* have been thought of, exemplified by SIMP (see [5.2.2]). As well, in the negotiation processes for design and development the most important was seen as to be able to provide something that could support exactly what was seen as needed at that time without much reflection of possible future needs. As in general the support for big changes was poor *only small changes* at a time was accepted. In addition, in MISAU, where

more or less all design decisions were made, the *focus was much on the central needs*. The focus on *central control* made so that real users of the system was locked out of design and development processes, something, if existent, could have caused some positive impact (see [10.2.2]). These issues might be especially critical when there was in general no specific investigation of what was behind the current problems. For instance, by not counter the reasons for how Sisprog did not have the ability to support the organization, but merely support immediate needs, developers of SIMP did not manage to solve the legacy problems of Sisprog. SIMP expands and improves immediate needs. However, it does not support, to a significant extent, any variation or changes in social practice. It is as rigid as Sisprog when it comes to content and informative flexibility issues. Although extending the content, it is already seen as inadequate for health management ([5.2.2]). By expanding the areas of use (being an integrator) and in addition being more embedded into organizational routines, but not solving the real legacy problems, SIMP is also expanding the legacy challenges for the organization. Similarly, priorities for DHIS and Modulo Basico were set to be covering immediate, centralized, needs, without reflection of consequences for other parts of the organization or later. Social structures of signification and legitimation among decision makers in MISAU ([10.2.2]) generated severe consequences for design of the technical systems. With *provision* of more *resources* by MISAU the implementation of design choices might have been better, so that the systems could not only support immediate needs, but also being more flexible for future/other needs.

Implementation and support processes
Already with the first computerized application in the Mozambican health sector; Sisprog, it was less thought of how the application could sustain supportiveness. Not only did the rigid user possibilities hinder the application, but also how the organization handled how to deal with it when new needs arose. After the developer(s) had left, no technical competence was maintained, and source code was gone. Similar problems have been found for SIMP. Even though technical support is present, its usefulness is of questionable character (see [5.2.2]).

In implementation efforts of the HISP approach and the DHIS software priorities and perceptions of power holders clearly influenced the legacy systems resolving processes. With demand for continuance of old routines in addition to new and no provision of additional resources, social practice among health management was sanctioned by central power *favouring status quo* rather than any change. When in addition typical potential users normally did not see big advantages of the new system also taking into consideration extra work load, change was harder to achieve.

It is to be said that this study does not state that social practice always leads to legacy systems[15]. However, from the Mozambican case there seem to be certain characteristics in the social systems which typically are in play. Change-resisting and change-restricting social structures have given the unintended consequences of having legacy systems:

[15] Nevertheless, is it possible to form systems which will support social practice of its target context forever?

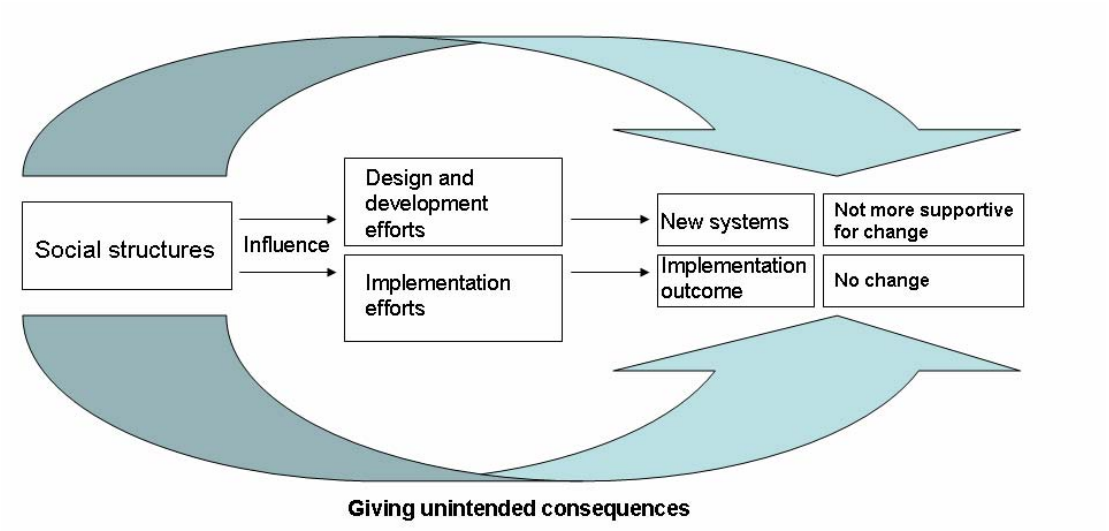


Figure 33: Legacy systems and no change in the social system after development and implementation efforts as unintended consequences of social structures influencing those processes

- Priorities influencing the design and development processes give resistance to developing an enabling HIS, exemplified by the outcome of the development processes of SIMP and the Modulo Basico. The legacy challenge continues and grows as new legacy systems are developed and implemented
- In the case of DHIS customization in 2004, priorities influencing the design and development processes resulted in a customized system which had gone from being relatively supportive to constraining.
- Priorities by decision makers influencing implementation efforts have restricted the outcome in regards of replacing legacy systems, as seen with the HISP efforts in Mozambique.

Social structures may inhabit *legacy* tendencies themselves. Change is hard to achieve under the influence of priorities of power holders both in regards of developing better systems and implementation of them. This research suggests that the legacy systems problems may typically be unintended consequences of structuration processes where *legacy social structures* are present, and where legacy social structures mean:

Legacy social structures: If social structures of the social system resist change or do not enable evolution of the social system in a desired direction, they function as legacy structures for that social system.

In relation to legacy systems theory (Bisbal et al., 1999) and how to deal with legacy systems this indicates that although strategies for pragmatic technical solutions are important, it is as much important to deal with the social system and the actors in play in legacy systems replacement efforts.

With the understanding of legacy systems and their challenges obtained in this discussion I will lastly suggest a strategy for replacing legacy systems in the Mozambican context, which might also be valid for other or similar contexts.

10.3 Strategy for Change

I will here comment upon the conception of installed base from information infrastructure theory ([2.4.4]), and propose a strategy for change which takes into consideration the developed understanding from the previous discussions.

Dealing with the Inertia of the Social System

According to Hanseth (2001) an information infrastructure is typically an evolving, shared, open, and heterogeneous installed base. Because of the complex socio-technical composition of the installed base it is seen upon something which is hardly controllable. Therefore change efforts of the installed base should rather be conceptualized as cultivation than construction to emphasize the uncontrollable characteristics. One might influence the installed base, but changing it in precise directions is seen as more or less impossible.

In Skobba (2003) change challenges in the Mozambican health sector were examined through the lenses of Information Infrastructure Theory. The failure of the installed base of the organization regarding enablement for change was explained through showing important lack of support for openness, enablement, sharing and heterogeneity in the current technical systems (Skobba, 2003, p. 172-173). The view of installed base failure in regards of technically obsolete systems is as well commonly supported by Information Infrastructure literature. *Complexity* in, and embeddedness of, *technical* systems are typically described among main causes behind a change resistant installed base (Hanseth and Monteiro, 1998; Hanseth and Braa, 2000; Hanseth, 2000).

However, as seen from former discussion, somewhat differing from the typical view of an installed base, the installed base of the Mozambican HIS has the following characteristics:

- Uncomplicated technical structures
- However, the installed base is still very resistant to change (also technical parts) although there is no strong reason for it in regards of technical issues

As already discussed and argued for above, legacy social structures are as well an important factor for the resistant installed base, and in the Mozambican context, probably a major cause ([10.2.2] and [10.2.3]). Social structures among users and decision makers give higher resistance to change at any level. Seen from [7.2], when new, enabling systems are introduced no changes are observed due to resistance for change in social structures, and a tendency is that new systems are typically as resistant for changes in social practice as the old systems because of unfortunate priorities by stakeholders. These issues lead to how the challenges should be tackled.

The analysis and discussion have showed that there are several aspects which have to be taken into consideration when one is going to formulate a change strategy.

A major challenge becomes this: Big changes at a time seem hard to accomplish. This is not uncommon. For instance, Hughes (1987) concluded with that complex social systems change only in the chaos of dramatic crises. This actually might contributes to explain the relative success of the HISP project in South Africa, as the will for change in the health sector, and in the society as a whole was high at the time HISP processes initiated in there (Braa and Hedberg, 2002). The happenings in South Africa at that time (end of apartheid regime) was probably more or less the opposite of a crisis, however, the point is that major changes in the whole society was due and wished for.

It seems like only small changes are possible at a time in the Mozambican health sector. Then, how to still support organizational change and development in the HIS if design of the new HIS assumes very few changes and improvements compared to the old? There is a dilemma in this point, also brought about by Heeks at al., (1999); as they mention the problematic issue in only doing small changes between old and new for easier diffusion and accept, which then compromise the positive effect of the new system as it probably much resembles the old.

To be able to solve this, the IS must then support very near current social practice and at the same time enable needs induced in the time-space distanciation. From former analysis and discussion this means that the software must have certain properties regarding flexibility (see [10.1.1]). In addition, there must be a technical support network surrounding it so that unforeseeable needs may be supported when emerging; maintaining the flexible properties of the system (ibid.).

Formulating a change strategy

Information Infrastructure theory introduces mainly two strategies when it comes to changing installed bases (Hanseth, 2001).

- *Revolutionary strategy;* the constraining technology will be replaced so that new may enable future evolvement of the installed base.
- *Evolutionary strategy;* where backward compatibility or gateways between new and old technologies makes smaller changes at a time, and hence less resistance is probably met.

Often the revolutionary strategy is seen as too risky, due to that much must be changed at once. If something then fails, the whole infrastructure may fail regarding what it is meant to support. However, although evolutionary strategies are seen as less risky, the Mozambican case illustrates a potential big problem with these:

In the Mozambican HIS typically gateway solution strategies have been chosen for technology when new needs have arisen in the organization. For instance, Sisprog was not enabling organizational changes, and among other reasons, because of this, SIMP was made, where a one-way-directed gateway between them (from Sisprog to SIMP) ensured that data from Sisprog are maintained in SIMP. However, the inability for SIMP as well to adapt to new needs, in addition to that the problems of Sisprog are not solved in any way, demonstrate a great risk regarding gateway solutions. If not replaced by proper technology the installed base of un-supportive technology

grows bigger and stronger, and makes the installed base even more resistant to change.
An aspect a bit particular to the part of the Mozambican HII which I studied is that it is, on a technological level, of relatively un-complex nature. This gave us, when we were working on customization of the DHIS software in December 2006, a golden opportunity to formulate a strategy which aimed at maximizing the possibilities to open up the installed base by enabling changes in social practice with minimized risk of failure and, hopefully, political resistance. Due to the fortune of having a very customizable software solution in the DHIS, we could enable replacement of all current constraining technological artefacts, at the same time as old routines were supported. One can say we used both strategies for change presented in Information Infrastructure theory (Hanseth, 2002), but at different levels in the infrastructure:

Technology level: Revolutionary approach where all old technology would be replaced. With the DHIS software we could replace Sisprog, SIMP and BES.

Social practice level: Evolutionary approach where current routines and needs for information were enabled through customizations of new software (for instance replication of SIMP reports); embedding current social practice and perception about what was important for organizational operation among power holders, into the new system. The enablement for old routines to continue is important due to the resistance for change in social practice, caused by the legacy social structures. At the same time, the DHIS software would then enable potential differences in needs at different loci and time in the social system. In this way, an uneven evolvement of the social system is also supported. By offering flexibility for local differences, special needs and interests for information among health management would be enabled without involving central bureaucracy or compromising central standards.

At the two different levels the approaches would have to be adjusted to the context. At the technology level it would be important to discontinue old systems, meaning that a new installed base of technology would be *constructed*. Applying a construction strategy for parts of the installed base can be possible, probably due to the relatively simple structures of the already existing systems, and the flexibility of the new system.

To make this possible in Mozambique, top level support is required. Hanseth (2001) claims that it is easier to influence an installed base if there are strong bases of power. This is the case of Mozambique, where MISAU functions as a main power centre. As seen from the case, if for instance discontinuance of old systems is not allowed, it diminishes heavily the probability for a new system to be taken into use. Obtaining support from top level is not necessarily very easy, as seen from the case. However, the strength of the strategy is to support current social structures, which means that no major changes have to be initiated in the switch.

Even though the new system enables current practice by applying an evolutionary approach to the social practice level, crucial parts are remaining. The objective is not only to have a system which supports social change. A specific aim is as well to deliberately change social practice (see [4.1.3]).

Cultivation and Social gateways

Structuration theory proclaims that social structures to only exist through social practice. What then becomes obvious is that an installed base of the social system is only instantiated in processes of structuration, which means social practice. Orlikowski (2000) argues that emerging structures is an appropriate way to look upon technology in its interaction with human agency. Social structures heavily shapes the use of technology, which again means that to be able to change the installed base of social practice in a certain trajectory, cultivation of social structures are crucial. To enable change in social structures, which is important for the Mozambican health care organization, *gateways* between legacy social structures and more appropriate social practice for the organization is a way of looking upon it. In the case of Mozambique, HISP could function as such a gateway, where routines for better health information use can be cultivated through training and support processes for improving social practice accordingly to the organizational objectives. However, this does not only apply for the users of the systems. Social structures among agents holding power must be cultivated as well, so alignment for a better functioning HIS as a whole may be reached. Since the legacy systems are unintended consequences of social practice, this practice has to be cultivated for change. For instance, it seems like some stakeholders in MISAU has missed to see the big difference between the Modulo Basico and DHIS/HISP. Even though both systems may support current social practice (at least as seen from MISAU), there are big differences in how the systems may continue to have these supportive properties. If decision makers do not possess knowledge regarding matters like this, there is a chance for that the organization will continue to have legacy systems problems into the future. Additionally, as a consequence of the unpredictability of social systems trajectory ([2.2.3]), there is a need for sustained technical support to maintain the flexibility of the technical systems. The training of the students from the UEM will hopefully be a start for creating and maintaining such a network.

Summary

Drawn from the Mozambican context, it becomes evident that different installed bases of different contexts may have different challenges which have to be tackled differently. This is also supported by Sæbø and Titlestad (2003), who argue for that cultivation processes must be context sensitive themselves. In the Mozambican health sector context it seems that the main challenges lie in the social structures, and hence these should be prioritized in implementation and change efforts. Claiming that any installed base is more or less uncontrollable (Hanseth, 2001) may be a strong statement. At least, it is probably possible to control parts of it under certain conditions. In the Mozambican case, it is evident that many of the technical systems are easily replaceable by other technology.

11 CONCLUSION

The research presented in this thesis is from interventions in the action research project of HISP in Mozambique. I will here briefly summarize findings from my study in relation with my research objectives. Under the main research objective, commented upon lastly, relevance of conclusions will be argued for by relating the findings to other contexts.

- *Study how ISs may function as enablers and/or constrainers for social practice taking into account social systems heterogenic characteristics*

By investigating the different HISs from the study some implications were suggested regarding how a HIS may support local variation and change over time regarding organizational needs. The study of Mozambican case in particular and the HISP project in general generates knowledge about two crucial aspects for maintenance of the enabling properties of a system in practical terms. 1) Flexibility for users as a design feature in the systems. 2) Technical support structures are needed through the lifetime of the IS to maintain its flexibility since identifying future needs may be near impossible. Strong technical support has been present for the South African HIS, where continuous development and improvement after users needs have been going on for almost a decade already, keeping the system in a constant state of being flexible. Need for sustained flexibility is typically not thought of by central stakeholders in the Mozambican health sector, with accompanying problems.

In the legacy systems literature there are differences in how legacy systems are described. It was shown that these represented complementary qualities. Both general issues and specific context conditioned matters must be understood for enhanced comprehension of legacy system problems. Acknowledging the heterogeneity of social systems also means that ISs can be supportive for some parts of the organization while not for other parts at the same time, making concepts like success and failure regarding ISs more complex.

- *Study challenges of dealing with ISs that are not supporting the organization*

A problematic issue for the Mozambican health sector is how unsupportive ISs have been dealt with. Immediate needs have been prioritized without much consideration of which consequences design choices may bring in the future. By supporting introduction of small changes only, or even favouring status quo, the result has typically been that new systems inhabit the same problematic characteristics as the old.

A potential problem, especially noticeable in centralized settings as the Mozambican, is that decision makers are organizationally far away from the real users of the systems. Decision makers know little about users needs caused by sparse communication between hierarchical levels. Priorities regarding organizational development are then more shaped after central presumed needs. This reinforces power structures, and hinders other parts of the organization to evolve, indicating the importance of cultivation of stakeholders' perceptions.

The way support from top level was given for the HISP project challenged development and implementation efforts. For instance, health management had to continue old routines at the same time as they did not have to follow HISP efforts. This hampered the implementation processes, also caused by lack of resources as time constraints among health management.

A strategy to solve the dilemma of how to still support further organizational change when the new IS has to support exactly what is there already was suggested. Due to the legacy systems problems in the Mozambican HIS it was suggested to take a revolutionary approach at the technical level of the installed base. However, because of the change resistant social system, an evolutionary approach was suggested on the social practice level. Less political resistance may then be present. By implementing flexibility in the IS, change is possible at the same time as current routines and priorities can be enabled. In the case of the Mozambican health sector, HISP could function as a gateway cultivating organizational routines through training and negotiation for further political support as a part of the evolutionary approach.

- *Investigate conditions for improvement of Health Information Systems in a developing country's setting*

- Legacy systems resolution is made difficult by centralized governance with focus on immediate needs rather than long term solutions. Centralized institutions may also have problems in HIS development and implementation because the distance between decision makers and real users is high. Less knowledge about users needs among decision makers caused by poor communication creates less supportive systems.

Similarly, according to Lungo (2007), HISP implementation efforts in Tanzania have been hindered by the Ministry of Health not giving full support. Permission for doing piloting and research is granted, however, not at the cost of changing any existing routines. A crucial factor for obtaining support from central stakeholders has been that the existing reports must be replicated into the smallest detail, regardless of the possible enhancement of informative capacity the new system may provide for the users (Lungo, 2007). According to Sæbø and Titlestad (2003) and De Vibe (2005) the adaptability of the DHIS generated much interest among lower levels health management in the centralized setting of Cuba. However, lower level workers had to comply with central power, which in the end did not comply with HISP efforts. In the end the project was halted because of absence of top level support. In contrast, in the South African health organization decision makers are typically much closer to real users, indicating that real needs are better known as well. Braa and Hedberg (2002) states that proximity to users and implementation of user needs are main causes of the relative success of the South African HIS.

- Flexibility in a system enables piecemeal introduction of changes. By this it may support current routines and at the same time support further organizational change.

Braa (2005) claims one of the reasons for the success of the DHIS software in the South African health sector is because of its flexibility for users. Hanseth (2002) claims that flexibility in technical components is crucial for openness and enablement of the evolving installed base. Buddhe et al. (1991) argue that IS development is a

continuous process for adapting an application system to rapidly changing social practice in the target social system (organization).

- Construction of parts of an installed base may be possible under certain conditions; organizational support being a prerequisite.

Studying development projects for mobile content services in two Norwegian telecommunication companies, Nielsen and Aanestad (2004) argued that a balance between control and autonomy of technology of the installed base could and should be considered and steered.

Future research

Cost and risk analyses: An issue not taken much into consideration in this thesis, however important in practical terms, is the relative cost of implementing different flexibility needs in software in relation to what is gained from having it. Even though this research indicates that legacy systems problems may be postponed by appropriate design and implementation processes, it can seem like a destiny for most systems is to, in the end, become legacy systems. An issue then becomes of how the cost of keeping a system flexible relates to the alternatives, with the involved risks.

LIST OF ACRONYMS

BES *Boletim Epidemiológico Semanal*
Weekly HIS for epidemiological data

DDS *Direcção Distrital de Saúde*
District Health Department

DPS *Direcção Provincial de Saúde*
Provincial Health Department

DHIS District Health Information System
The computerized health information system tool of HISP

HIS Health Information System

HISA Health Information System Approach
Another HIS approach in Mozambique

HISP Health Information System Programme

ICT Information and Communication Technology

IS Information System

MODULO BASICO The software of the HISA approach

MISAU *O Ministerio da Saúde de Moçambique*
The Mozambican Ministry of Health

NUFU Norwegian Programme for Development, Research and Education

PAV *Programa Alargado de Vacinação*
Vaccination Health Program

PHC Primary Health Care Approach

RHINO Routine Health Information Network

SIMP Sistema Integrado de Monitorização e Planificação

SIS *O Sistema de Informação da Saúde*
The name of the National Health Information System in Mozambique

SIS.D *O Sistema de Informação para Saúde Distrital*
Portuguese for District Health Information System

SMI *Saúde Materno Infantil*
Mother and Child Health Program

ST Structuration Theory

WHO World Health Organization

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APPENDIX A

Table structures in Sisprog

SIMP imports Sisprog tables, and to replace Sisprog, the export application so makes tables structured as the Sisprog tables.

To understand how things are done in the export application, one must know how Sisprog is structured as well. Inside the folder (called SISC) of the National version of Sisprog, each province has its own folder. Inside these, each year has its own folder. Inside these "year" folders the actual data is stored in different tables. It then looks like this:

C:\SISC\"Province"\"year"\"data tables"

However, the province versions of Sisprog have no info in the folder structure about province, and look like this:

C:\SISC\"year"\"data tables"

The content in these tables can be divided into two categories; orgunit/hierarchy data, and routine health data.

1. Information about orgunits/hierarchy is stored in two tables, DISTS.dbf and UNIDS.dbf. In DISTS.dbf the district names in the current province are listed and given a district code. Population data and size of district are also provided, among other things:

DISTS : Table

CODI	NOME	POPUL	AREA	GA_1	MT_1	GA_2	MT_2
01	Bilene	166223	2719	4	98	17.1	70
03	Chibuto Dist	176212	5878	4	98	17.1	70
04	Chicualac.	37095	16035	4	98	17.1	70
05	Chigubo	14934	13952	4	98	17.1	70
07	Chókwé Dist	238193	1864	4	98	17.1	70
08	Guijá	63748	3589	4	98	17.1	70
09	Mabalane	28374	9580	4	98	17.1	70
10	Mandlakaze	173952	3748	4	98	17.1	70
11	Massangena	14808	10351	4	98	17.1	70
12	Massingir	23570	5858	4	98	17.1	70
13	Xai-Xai Cid.	149198	135	4	98	17.1	70
14	Xai-Xai Dist	218482	1749	4	98	17.1	70

Figure 34: The UNIDS.dbf table

In the UNIDS.dbf data about the health facilities are stored; type etc. and to which district it belongs. The district is shown as a district code, taken from the DISTS.dbf. The orgunits are also provided with orgunit codes:

UNIDS : Table

DCOD	CODI	TIPO	NOME	URBRUR	SNSPRV	PAV
07	02	CS	Conhane	RUR	SNS	*
10	30	CS	Incadine	RUR	SNS	*
07	01	CS	Chalucuane	RUR	SNS	*
01	07	CS	Mazivila	RUR	SNS	
01	05	CS	Incaia	RUR	SNS	*
01	04	CS	Praia bilene	RUR	SNS	*
01	03	CS	Chissamo	RUR	SNS	*
01	02	CS	Messamo	URB	SNS	*
14	20	CS	Bungane	RUR	SNS	
08	02	CS	Chimbembe	RUR	SNS	
14	19	CS	V.Lenine	RUR	SNS	*
10	20	CS	Muzamane	RUR	SNS	
03	03	CS	Malehice	RUR	SNS	*
02	02	CS	Chibuto	URB	SNS	*
03	01	CS	Alto changane	RUR	SNS	*
03	10	CS	Nwavaquene	URB	SNS	*
03	06	CS	Muxaxane	RUR	SNS	*
03	02	CS	Chipadja	RUR	SNS	*
06	02	CS	Chokwe	URB	SNS	*
08	01	CS	Guija	RUR	SNS	*
13	01	HC/P	XAI-XAI	URB	SNS	*
10	01	HR/G	Manjacaze	RUR	SNS	*
14	01	HR/G	CHICUMBANE	RUR	SNS	*
03	05	HR/G	Chibuto	URB	SNS	
07	12	HR/G	Chokwe	URB	SNS	
06	01	HR/G	Chokwe	URB	SNS	*
02	01	HR/G	Chibuto	URB	SNS	
09	03	PS/A	Pfukwe	RUR	SNS	
12	04	PS/A	Zulo	RUR	SNS	*
10	15	PS/A	Chalala	RUR	SNS	

Figure 35: The DISTS.dbf table.

Note that both tables have a column name “CODI”, however that they have different meaning. In DISTS.dbf the “CODI” means district code, but in UNIDS.dbf “CODI” means orgunit code, and the district code is given the name “DCOD”.

2. The tables with routine data follow the logic of the paper forms that are sent from the district offices to the province office. One table for each paper form. There is one exception, though. In the B07 paper form there are two variables on the backside of the form which are aggregated into district totals, while the other variables on the B07 are in facility aggregates. The structure of the Sisprog tables can not reflect data of different aggregation levels in one and the same table, so these two variables are saved in another table than the rest of the data from B07. The tables Sisprog makes which are of interest for us (the ones SIMP is importing) are the following:

A04.dbf (from A04 paper form; District totals)
B06.dbf (from B06 paper form; Facility totals)
B07.dbf (from B07 paper form; Facility totals)
B07_Reg.dbf (From B07 paper form; District totals)
B08.dbf (from B08 paper form; Facility totals)

The tables are structured like this:

Period; Ano, Mes:
Location; DCOD, UCOD.
DCOD = district code from the DIST table (see above),
UCOD = orgunit code from UNIDS table (see above).
The exception from this structure we find in A04.dbf and B07_reg.dbf tables. These contain data at district aggregate, so only DCOD exists in the tables, as the UCOD part is aggregated away.

The rest of the columns contain collected routine data.

B06

Ano	Mes	Dcod	Ucod	Cp1	Cs1	Cp2	Cs2	Ccb	Ccm	Snum
05	01	04	01	95	200	366	200	257	35	1
05	01	04	12	179	297	179	454	420	34	1
05	01	04	07	105	0	168	0	135	26	1
05	01	04	10	42	177	49	264	235	25	1
05	01	04	04	78	654	102	735	700	35	1
05	01	04	11	69	607	167	795	891	71	1
05	01	04	13	9	30	27	45	35	10	1
05	01	04	05	15	49	15	49	58	0	1
05	01	04	06	132	0	240	0	0	0	1
05	01	15	01	76	169	177	301	151	15	2
05	01	15	04	76	31	76	64	32	6	2
05	01	15	03	32	124	42	146	170	13	2
05	01	12	01	40	225	45	332	300	68	3
05	01	12	03	38	133	56	265	180	44	3

Figure 36: Example of table containing routine data. This is parts of the B06 table

APPENDIX B

Structure of the Export application (DHIS to SIMP)

To know which data to export to the Sisprog tables, the application needs information about from where and when. The user gives this input by choosing province, year and month.

Internal tables for the export application

The export application uses several tables (in the database Sysforms.mdb in the application folder) to store user input, as well as important information regarding the link between the SISD database structure and Sisprog structure.

The link tables

The SISD database uses –one- unique code for every orgunit in the database (OrgUnitID in the table OrgUnit), while Sisprog needs three; province, district and facility. Also, to understand the choice of internal tables in the export application, we need to know how SIMP is reading the Sisprog tables, and how the Sisprog file structure is constituted, see above.

SIMP exists in one version for every province, so does Sisprog. This means that information of in which province the application is installed is implicit. However, the SISD–SIMP export application is going to work for the whole country, and the information of which province it is going to be used in must be explicit. This is why it must be a user input regarding this. To differentiate between the provinces the export application uses one table for each of the provinces, with a table name from the province name. These tables contain linkages between the DCOD and UCOD from Sisprog and the corresponding orgUnitID from the SISD database. When so the export procedure is running, it reads these linkages to get the correct data from the SISD database and put it correctly into the Sisprog structured tables.

External tables

The application uses table templates from Sisprog to produce tables which SIMP can read.

Sisprog Tables

In the folder “sys” in the application folder there are template files for all the used Sisprog structured tables. When initiating the export, these are copied to a folder with name of the year for when the data to export are from. During export some temporary tables are made to facilitate the aggregation of the A04 and B07_Reg data. When export completed, the whole folder is copied to the right location (C:\SIS\) on the

hard drive, so SIMP can read the tables automatically. Or, if the user has chosen to export to a different drive, it will be placed to that drive.

One thing to remember, that the users also must know, is that if the user has chosen to export directly to SIMP, this means that no import needs to be done inside SIMP, nor will it work. The thing that has to be done is as follows:

- Start SIMP
- Press “Escolher menu”
- Write Username and password

From here there will be a difference. Normal procedure from here is to go to the “Tools” menu and choose “Importar Arquivos externos”. This will no more be necessary or possible, because this requires a floppy disc containing the Sisprog data to be inserted into the computer. So, the user should skip this procedure, and instead go directly to SIMP by pushing the “Iniciar SIMP”-button. To update the sheets, the user has to press “entrada dados”, tick “Estatistica” for the current year, and then “Abrir ficha”. Whenever there is a prompt for whether the user wants to copy data from SIS, the answer should be “yes” every time.

Figure 37: the user interface for the DHIS - SIMP export application

APPENDIX C

Application for Mapping organizational differences between Sisprog and DHIS

This application is made for three reasons:

1. If the Sisprog database used for mapping contains wrong information about orgunits,
2. If we, even after endless hours of checking consistency of the tables linking SISD to Sisprog, did not manage to catch all errors and mistakes,
3. If the export application is going to be used for a while, and the need to link new orgunits becomes an issue.

What it does:

- If there are entries from the Sisprog tables that are not linked to any orgunits in the SISD database, this can be done.
- If there are entries which are wrongly connected, these can be disconnected, and then linked again.
- If there are new orgunits that do not exist in the old Sisprog database, the user can still connect the new ones into the tables. The application then automatically makes appropriate DCOD and UCOD values, so that SIMP manages to read the tables.
- If there are obvious wrong elements in the Sisprog tables, non-existing orgunits, orgunits placed in wrong districts etc, these can be deleted from the tables.
- Remember, the data IN the SISD database should be correct when doing these mapping procedures.

Normally, after the initial check and correction the first time the application is taken into use, this is something that the users never need to think about. However, it is crucial that it is used if a new health facility is added into the SISD database, and used. Maybe it could be an idea to make a test when starting the Export application, whether there exists any new orgunits in the SISD database or not. If there are new orgunits, show a message that tells the user to enter the mapping application. This check follows the logic of one of the options in the mapeamento application. When the user chooses the “Carregar dados para ligar” the application checks whether there are any orgunits in the SISD database that are not linked for the province chosen. To make this to work as an initial test in the Export application, the code has to be re-written into VB6.

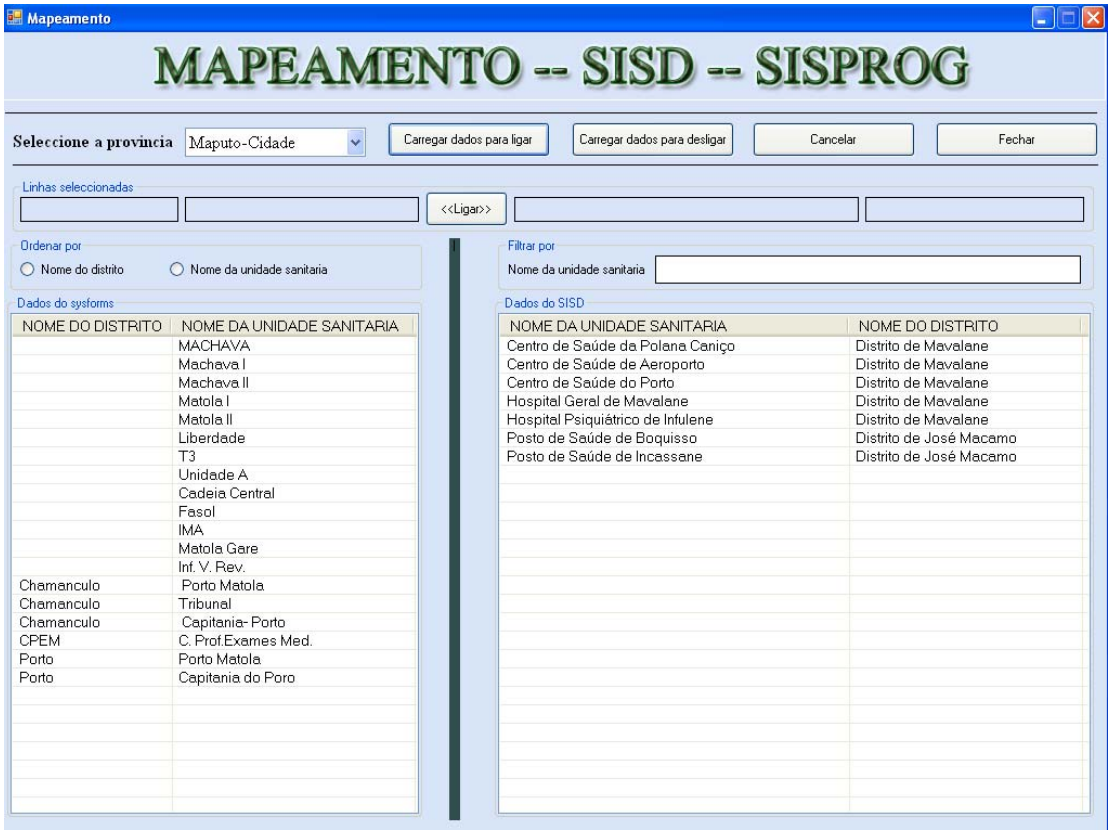


Figure 38: the user interface for mapping orgunits

APPENDIX D

Screenshots from Sisprog

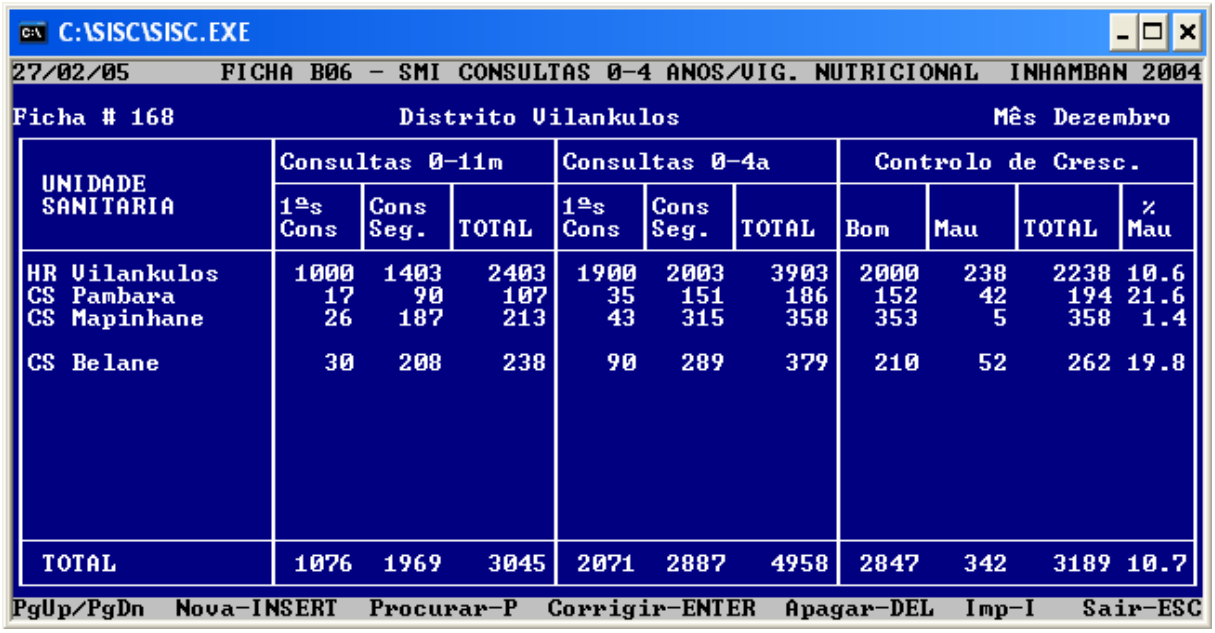
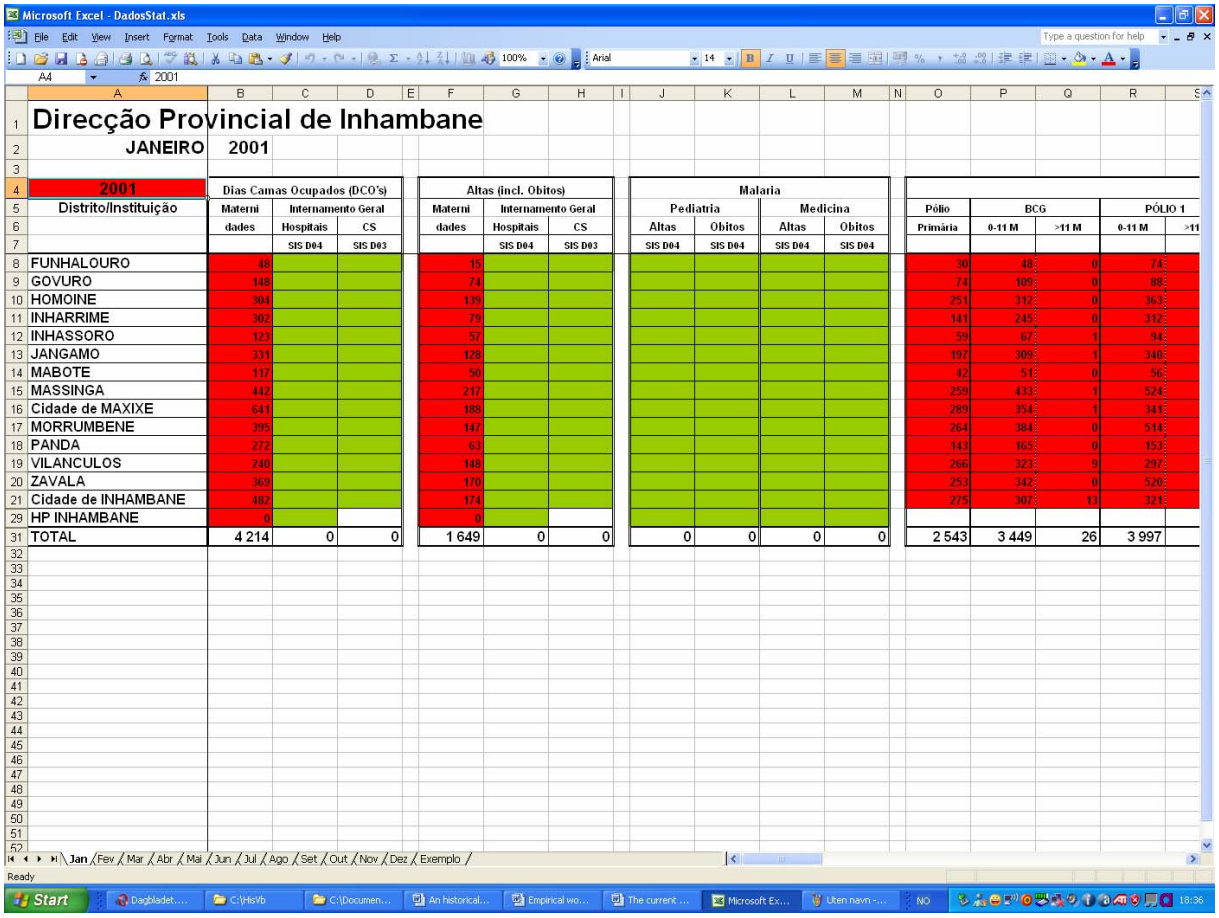


Figure 39: Showing the form B06 for introducing data in Sisprog

Figure 40: Showing screen where to choose what shall be entered

APPENDIX E

Screenshots from SIMP



Microsoft Excel - DadosStat.xls

Direcção Provincial de Inhambane

JANEIRO 2001

2001	Dias Camas Ocupados (DCO's)			Altas (incl. Obitos)			Malaria								
Distrito/Instituição	Materni	Internamento Geral		Materni	Internamento Geral		Pediatria		Medicina		Pólio	BCG		PÓLIO 1	
	dades	Hospitais	CS	dades	Hospitais	CS	Altas	Obitos	Altas	Obitos	Primária	0-11 M	>11 M	0-11 M	>11
		SIS D04	SIS D03		SIS D04	SIS D03	SIS D04	SIS D04	SIS D04	SIS D04					
FUNHALOURO	48			15							30	48	0	74	
GOVURO	148			74							74	109	0	88	
HOMOINE	304			139							251	312	0	363	
INHARRIME	302			79							141	245	0	312	
INHASSORO	123			57							59	67	1	94	
JANGAMO	331			128							197	309	1	340	
MABOTE	117			50							42	51	0	56	
MASSINGA	442			217							259	433	1	524	
Cidade de MAXIXE	641			188							289	354	1	341	
MORRUMBENE	395			147							264	384	0	514	
PANDA	272			63							143	165	0	153	
VILANCULOS	240			148							266	323	9	297	
ZAVALA	369			170							253	342	0	520	
Cidade de INHAMBANE	482			174							275	307	13	321	
HP INHAMBANE	0			0											
TOTAL	4 214	0	0	1 649	0	0	0	0	0	0	2 543	3 449	26	3 997	

Figure 41: Imported data from Sisprog. Note that only the hospital data of Hospital de Inhambane are not aggregated. All other facility data are lost during import, only storing district totals.

APPENDIX F

Screenshots from the HISA software

Figure 42: Showing HISA main screen, where one can choose from which former application one wants to introduce data and different possibilities. Notice that DHIS and SIMP are included…

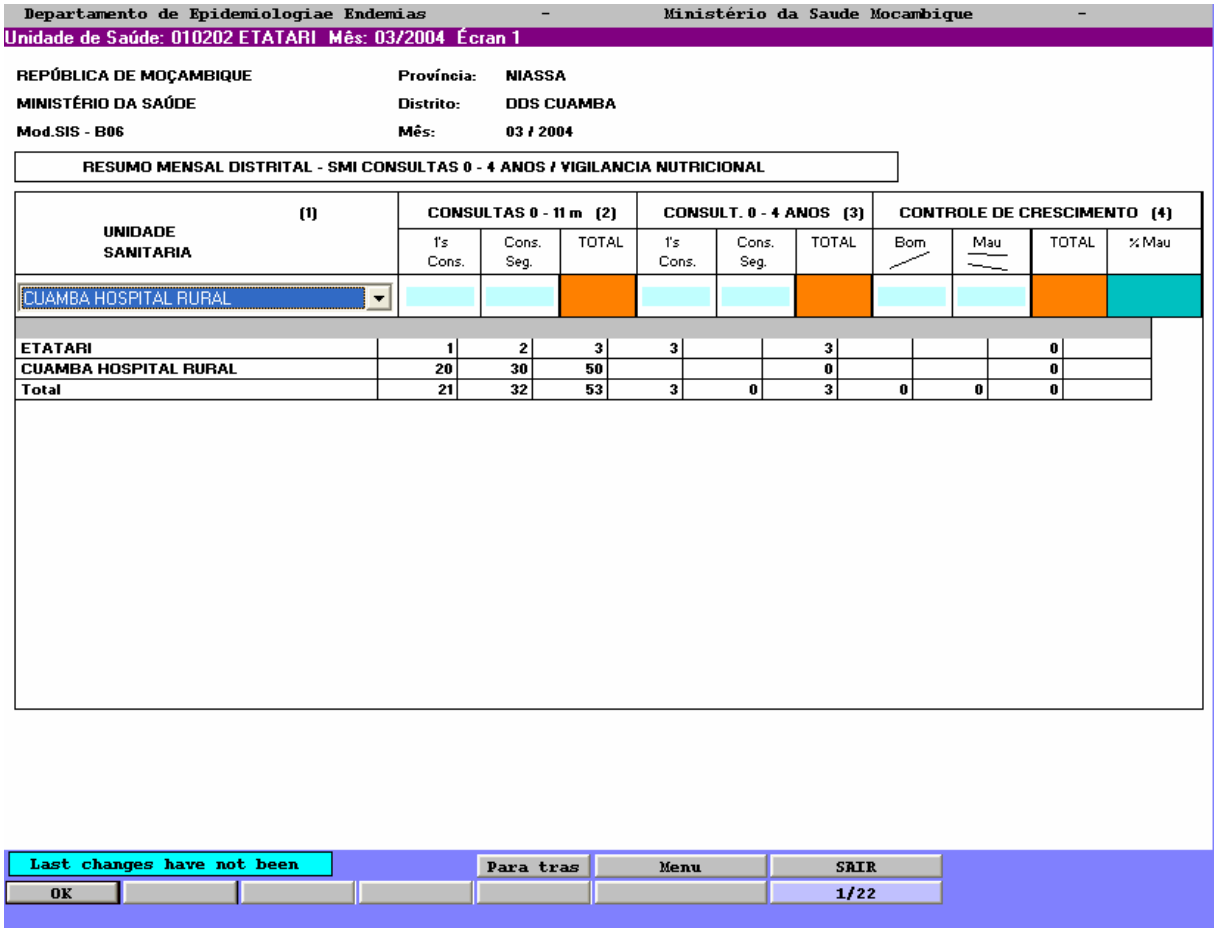
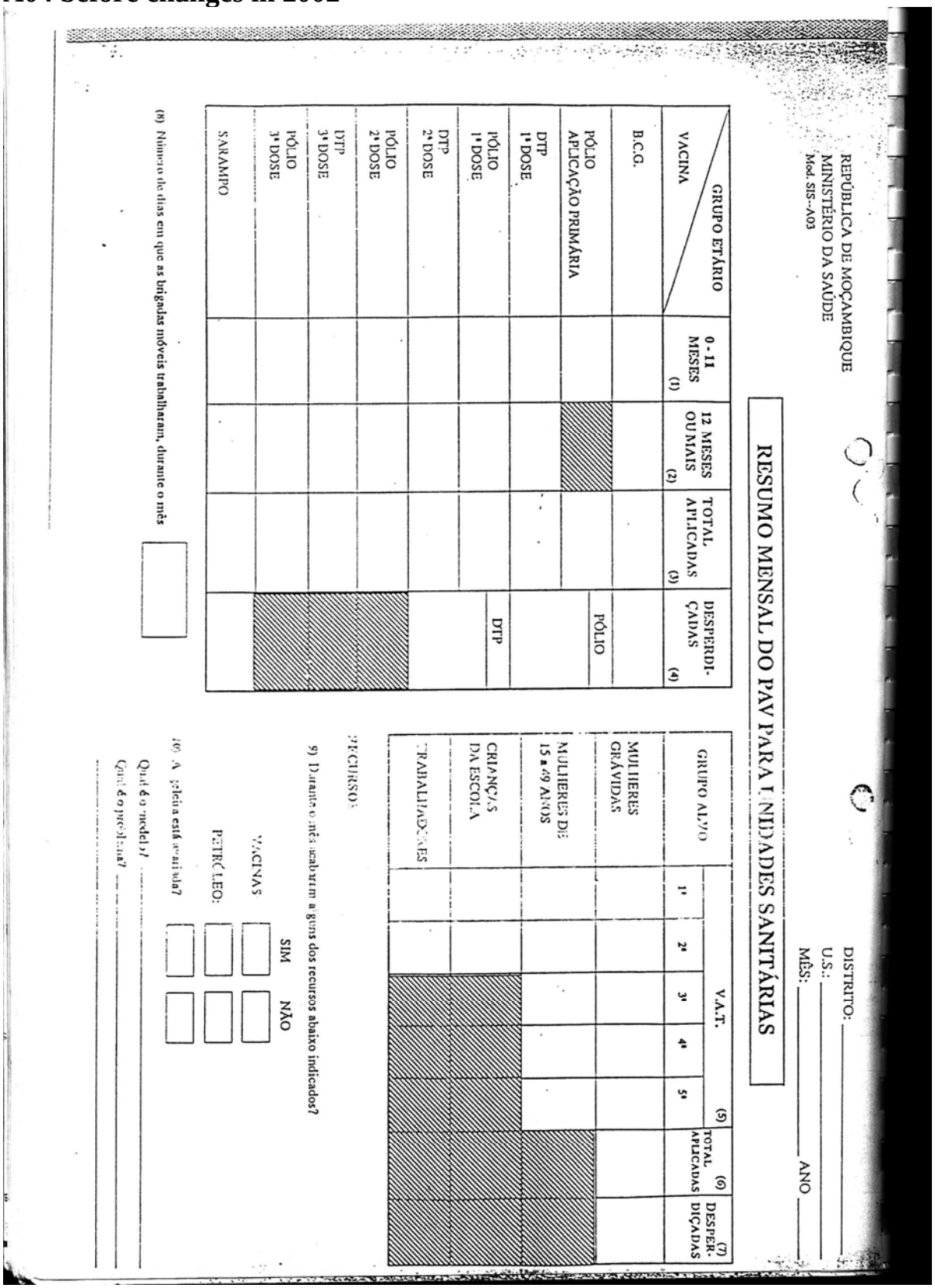


Figure 43: Showing a working model of B06 data entry in HISA. It was not finished at this stadium, and due to problems with screen resolution it seems a bit strange on this picture.

APPENDIX G

Paper System forms influencing design processes

A04 before changes in 2002



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
Mod. SIS--A03

DISTRITO: _____
U.S.: _____
MÊS: _____ ANO _____

RESUMO MENSAL DO PAV PARA UNIDADES SANITÁRIAS

GRUPO ETÁRIO / VACINA	0 - 11 MESES (1)	12 MESES OU MAIS (2)	TOTAL APLICADAS (3)	DESPERDIÇADAS (4)
B.C.G.				
PÓLIO APLICAÇÃO PRIMÁRIA				PÓLIO
DTP 1ª DOSE				DTP
PÓLIO 1ª DOSE				
DTP 2ª DOSE				
PÓLIO 2ª DOSE				
DTP 3ª DOSE				
PÓLIO 3ª DOSE				
SARAMPO				

GRUPO ALVO	V.A.T. 1ª	2ª	3ª	4ª	5ª (5)	TOTAL APLICADAS (6)	DESPERDIÇADAS (7)
MULHERES GRÁVIDAS							
MULHERES DE 15 a 49 ANOS							
CRIANÇAS DA ESCOLA							
TRABALHADORES							

(8) Número de dias em que as brigadas móveis trabalharam, durante o mês

PERGUNTAS:

9) Durante o mês acabaram alguns dos recursos abaixo indicados?

	SIM	NÃO
VACINAS		
PETRÓLEO:		

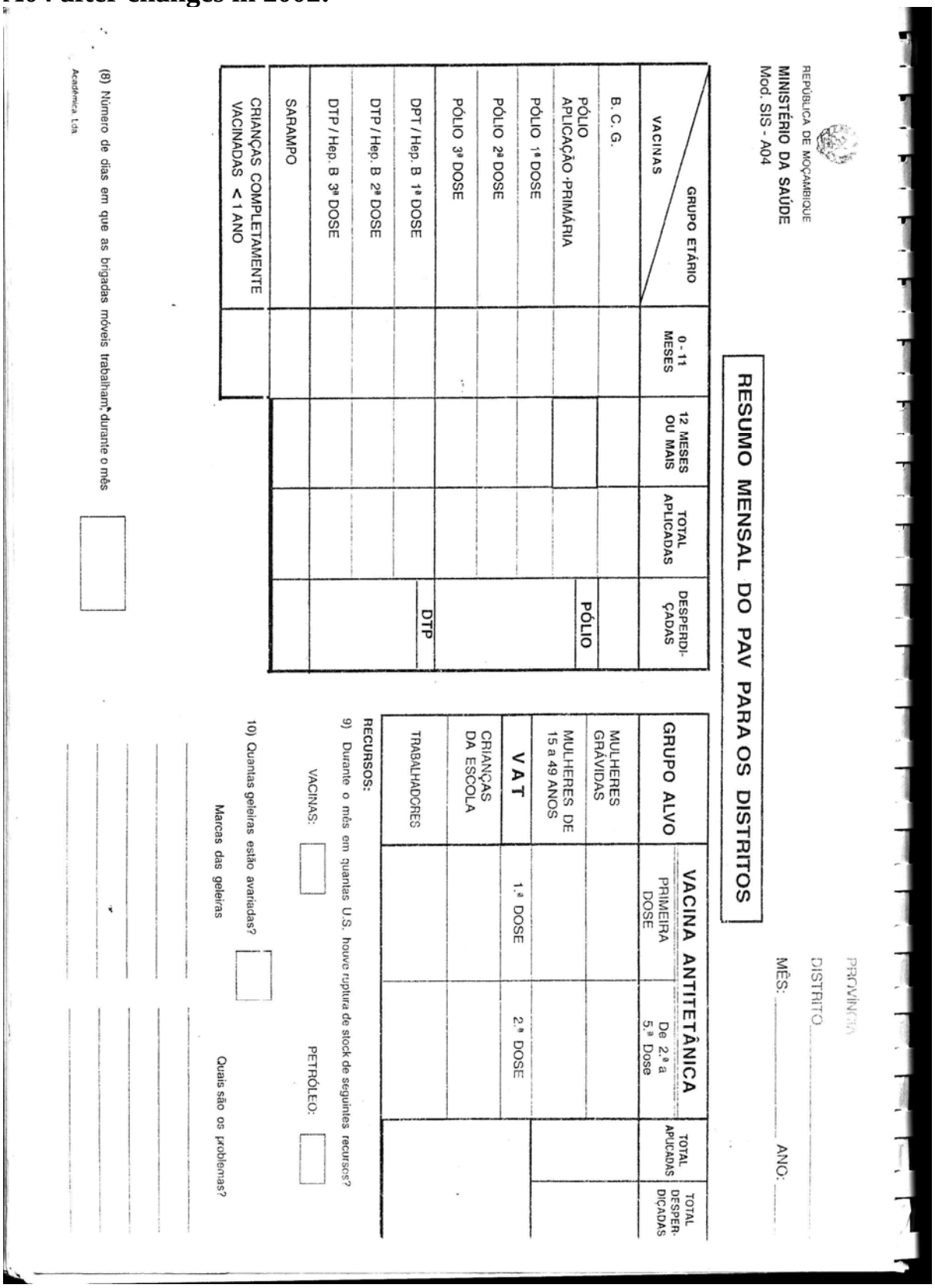
10) A geleira está avariada? ☐ ☐

Qual é o modelo? _____

Quando foi reparada? _____

Figure 44: A04 before changes in 2002

A04 after changes in 2002:



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
Mod. SIS - A04

PROVÍNCIA
DISTRITO
MÊS: ANO:

RESUMO MENSAL DO PAV PARA OS DISTRITOS

GRUPO ETÁRIO / VACINAS	0 - 11 MESES	12 MESES OU MAIS	TOTAL APLICADAS	DESPERDIÇADAS
B. C. G.				
PÓLIO APLICAÇÃO PRIMÁRIA				PÓLIO
PÓLIO 1ª DOSE				
PÓLIO 2ª DOSE				
PÓLIO 3ª DOSE				
DPT / Hep. B 1ª DOSE				DTP
DTP / Hep. B 2ª DOSE				
DTP / Hep. B 3ª DOSE				
SARAMPO				
CRIANÇAS COMPLETAMENTE VACINADAS < 1 ANO				

VACINA ANTITETÂNICA				
GRUPO ALVO	PRIMEIRA DOSE	De 2.ª a 5.ª Dose	TOTAL APLICADAS	TOTAL DESPERDIÇADAS
MULHERES GRÁVIDAS				
MULHERES DE 15 a 49 ANOS				
VAT	1.ª DOSE	2.ª DOSE		
CRIANÇAS DA ESCOLA				
TRABALHADORES				

RECURSOS:

9) Durante o mês em quantas U.S. houve ruptura de stock de seguintes recursos?

VACINAS: PETRÓLEO:

10) Quantas geleiras estão avariadas?

Marcas das geleiras

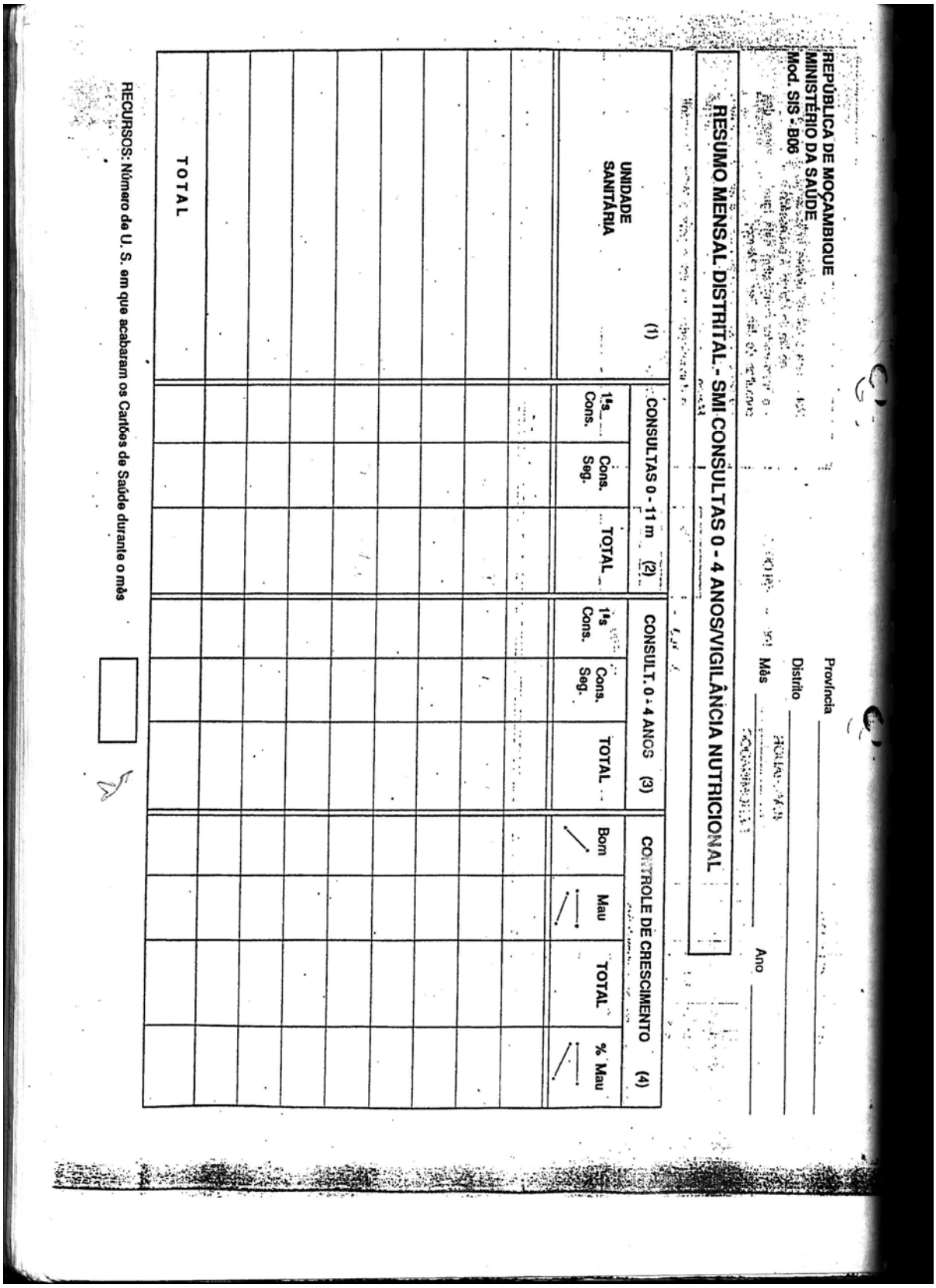
Quais são os problemas?

(8) Número de dias em que as brigadas móveis trabalharam durante o mês

Académica Lda

Figure 45: A04 after changes in 2002

B06:



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
Mod. SIS - B06

Província _____
Distrito _____
Mês _____ Ano _____

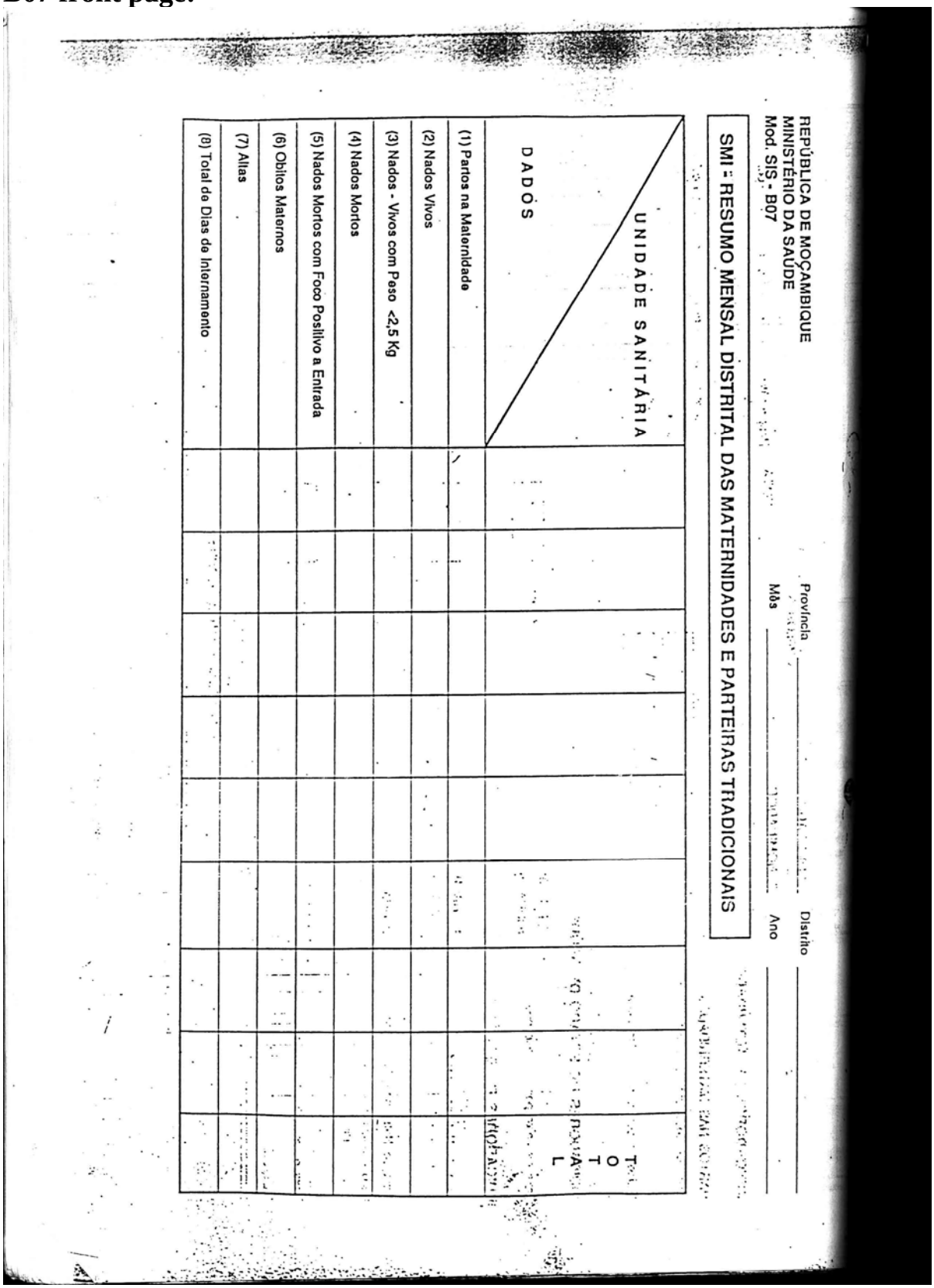
RESUMO MENSAL DISTRITAL - SMI CONSULTAS 0 - 4 ANOS/VIGILÂNCIA NUTRICIONAL

UNIDADE SANITÁRIA (1)	CONSULTAS 0 - 11 m (2)			CONSULT. 0 - 4 ANOS (3)			CONTROLE DE CRESCIMENTO (4)				
	1ªs Cons.	Cons. Seg.	TOTAL	1ªs Cons.	Cons. Seg.	TOTAL	Bom	Mau	TOTAL	% Mau	
TOTAL											

RECURSOS: Número de U. S. em que acabaram os Cartões de Saúde durante o mês

Figure 46: B06

B07 front page:



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
Mod. SIS - B07

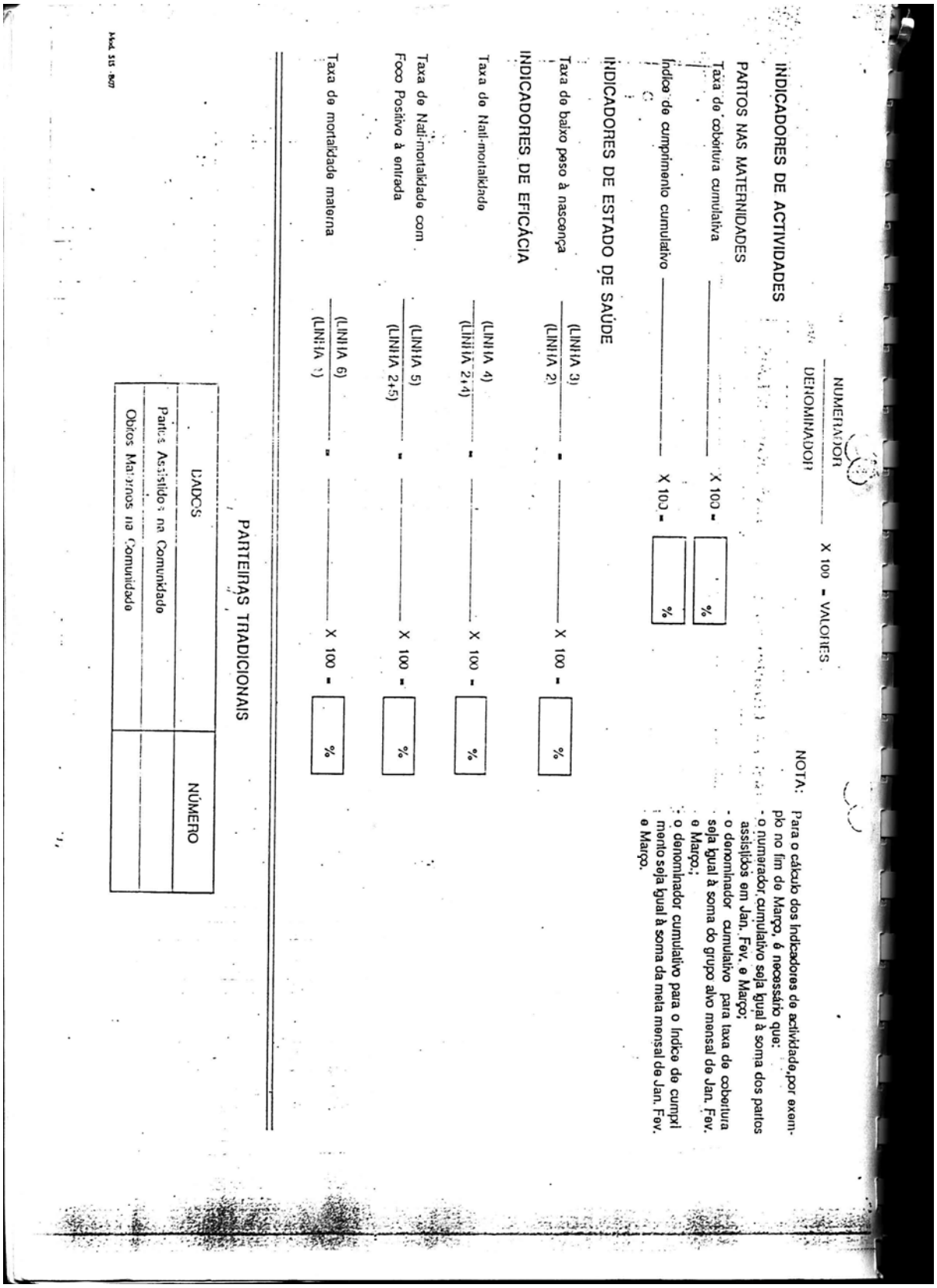
Província _____ Distrito _____
Mês _____ Ano _____

SMI – RESUMO MENSAL DISTRITAL DAS MATERNIDADES E PARTEIRAS TRADICIONAIS

DADOS / UNIDADE SANITÁRIA									TOTAL
(1) Partos na Maternidade									
(2) Nados Vivos									
(3) Nados - Vivos com Peso <2,5 Kg									
(4) Nados Mortos									
(5) Nados Mortos com Foco Positivo a Entrada									
(6) Obitos Maternos									
(7) Altas									
(8) Total de Dias de Internamento									

Figure 47: B07 front page

B07 backside:



NUMERADOR
DENOMINADOR
X 100 = VALORES

INDICADORES DE ACTIVIDADES

PARTOS NAS MATERNIDADES

Taxa de cobertura cumulativa _____ X 100 = | % |

Índice de cumprimento cumulativo _____ X 100 = | % |

NOTA: Para o cálculo dos indicadores de actividade,por exemplo no fim de Março, é necessário que:
- o numerador cumulativo seja igual à soma dos partos assistidos em Jan, Fev, e Março;
- o denominador cumulativo para taxa de cobertura seja igual à soma do grupo alvo mensal de Jan, Fev. e Março.;
- o denominador cumulativo para o Índice de cumprimento seja igual à soma da meta mensal de Jan, Fev. e Março.

INDICADORES DE ESTADO DE SAÚDE

Taxa do baixo peso à nascença (LINHA 3) / (LINHA 2) = _____ X 100 = | % |

INDICADORES DE EFICÁCIA

Taxa do Natl-mortalidade (LINHA 4) / (LINHA 2+4) = _____ X 100 = | % |

Taxa do Natl-mortalidade com Foco Positivo à entrada (LINHA 5) / (LINHA 2+5) = _____ X 100 = | % |

Taxa de mortalidade materna (LINHA 6) / (LINHA 1) = _____ X 100 = | % |

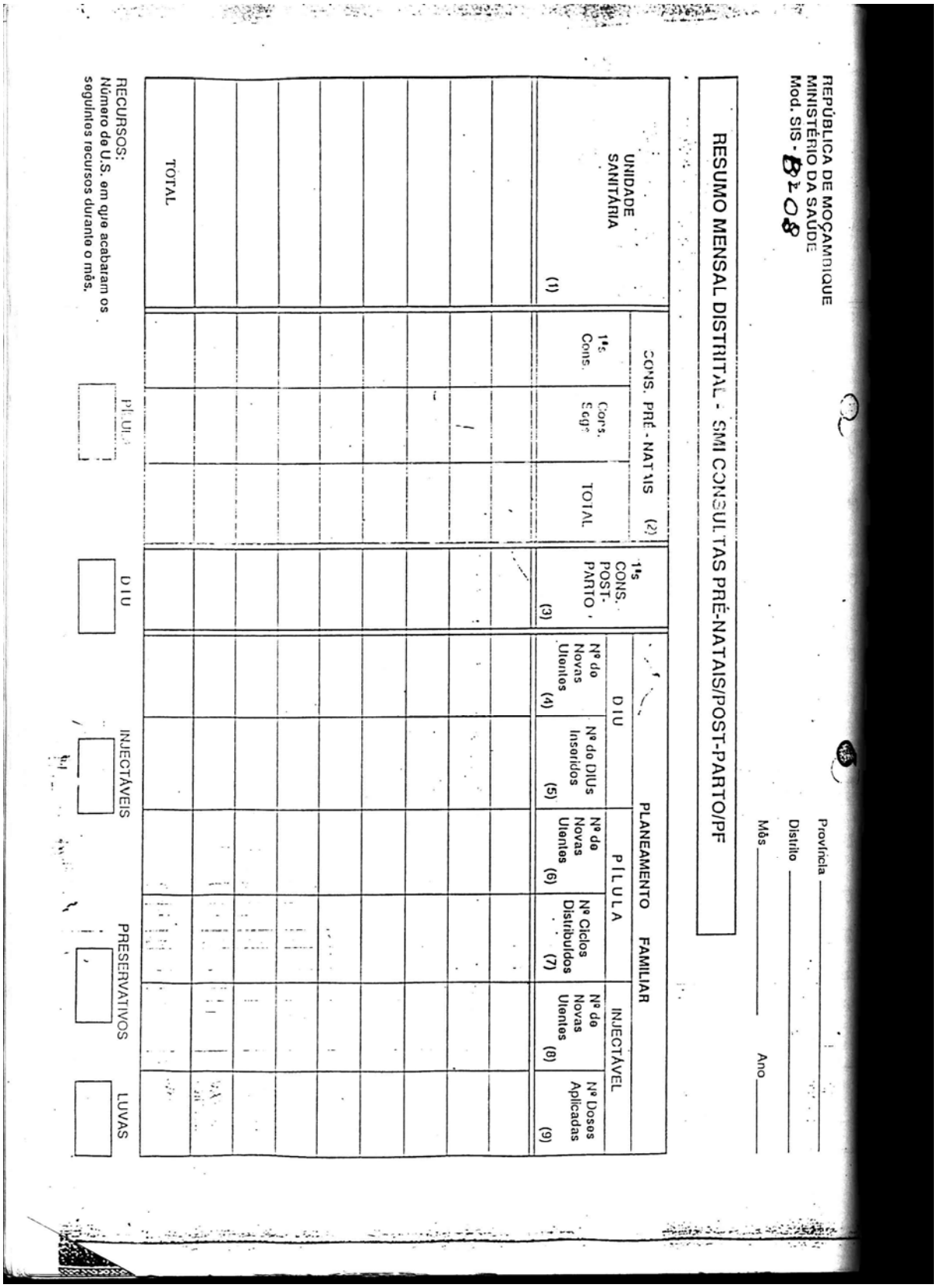
PARTEIRAS TRADICIONAIS

DADOS	NÚMERO
Partos Assistidos na Comunidade	
Óbitos Maternos na Comunidade	

Mod. SIS 807

Figure 48: B07 backside

B08:



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
Mod. SIS - B2 08

Província _____
Distrito _____
Mês _____ Ano _____

RESUMO MENSAL DISTRITAL - SMI CONSULTAS PRÉ-NATAIS/POST-PARTO/PF

UNIDADE SANITÁRIA (1)	CONS. PRÉ - NATAIS (2)			1as CONS. POST-PARTO (3)	PLANEAMENTO FAMILIAR						
	1as Cons.	Cons. Seg.as	TOTAL		DIU		PÍLULA		INJECTÁVEL	PRESERVATIVOS	LUVAS
					Nº de Novas Utentes (4)	Nº de DIUs Inseridos (5)	Nº de Novas Utentes (6)	Nº Ciclos Distribuídos (7)	Nº de Novas Utentes (8)		Nº Doses Aplicadas (9)
TOTAL											

RECURSOS:
Número de U.S. em que acabaram os seguintes recursos durante o mês.

PÍLULA

DIU

INJECTÁVEIS

PRESERVATIVOS

LUVAS

Figure 49: B08

Example of SIMP Report:

Direcção Provincial de Inhambane — **ANEXO 18**

Periodo de 1/1 a 31/10/2006

Análise da Situação - INTERNAMENTO

Distrito	Nº de Camas	Total Dias Cama/Ocupada (DCO) Jan-Out 2005	Jan-Out 2006	% Evolução	DCO Mes Notif.	% Taxa de Ocupação de Camas	Total de Altas * 2006	Tempo Medio Internam.	Rendim. Medio da cama	Intervalo Rotacao da cama	Total de Fundos Gastos em Alimentação: Em Dinheiro	Em Géneros	TOTAL	Fundos Gastos/DCO	OBSERVAÇÕES
FUNHALOURO	86	1,928	1,075	-44.2%	6	4.1%	922	1.2	1.1	27.2	0	0	0	0.000	
GOVURO	45	521	635	21.9%	6	4.6%	531	1.2	1.2	24.6	0	0	0	0.000	
HOMOINE	34	1,396	1,659	18.8%	6	16.0%	1,410	1.2	4.1	6.2	0	0	0	0.000	
INHARRIME	123	5,013	2,214	-55.8%	6	5.9%	1,914	1.2	1.6	18.4	0	0	0	0.000	
INHASSORO	70	1,496	1,058	-29.3%	6	5.0%	1,022	1.0	1.5	19.8	0	0	0	0.000	
JANGAMO	49	966	1,384	43.3%	6	9.3%	1,214	1.1	2.5	11.1	0	0	0	0.000	
MABOTE	52	851	1,334	56.8%	6	8.4%	1,162	1.1	2.2	12.5	0	0	0	0.000	
MASSINGA	55	1,154	1,246	8.0%	6	7.4%	1,163	1.1	2.1	13.3	0	0	0	0.000	
Cidade de MAXIXE	78	3,042	2,719	-10.6%	6	11.5%	2,492	1.1	3.2	8.4	0	0	0	0.000	
MORRUMBENE	231	4,331	644	-85.1%	6	0.9%	545	1.2	0.2	127.7	0	0	0	0.000	
PANDA	37	516	2,374	360.1%	6	21.1%	2,002	1.2	5.4	4.4	0	0	0	0.000	
VILANCULOS	79	2,000	2,337	16.9%	6	9.7%	1,890	1.2	2.4	11.5	0	0	0	0.000	
ZAVALA	74	2,115	649	-69.3%	6	2.9%	595	1.1	0.8	36.7	0	0	0	0.000	
Cidade de INHAMBANE	47	569	3,627	537.4%	5	25.4%	2,921	1.2	6.2	3.7	0	0	0	0.000	
HOSPITAL PROVINCIAL	458	8,581	4,491	-47.7%	6	3.2%	2,604	1.7	0.6	51.8	0	0	0	0.000	
TOTAL	*1,518*	*34,479*	*27,446*	*-20.4%*		*5.9%*	*22,387*	*1.2*	*1.5*	*19.4*	*0*	*0*	*0*	*0.000*	

<< DCO Maternidade HC e HP incluem Sala de Partos e Enfermeira de Obstetricia >>

Componentes do Grupo

Notas para Discussão
(1) Qualidade dos Dados
(2) Diminuição Acentuada da Actividade
(3) Taxa de Ocupação
- Muito Baixa
- Muito Alta
(4) Fundos/DCO
- Muito Altos
- Muito Baixos

Desempenho dos Distritos		
Baixo	Medio	Baixo

* Altas que incluem obitos

Distritos Desfavorecidos

Possíveis Soluções

(1) Supervisão dirigida
(2) Atribuição de Camas
(3) Revisão da Distrib. de Fundo
- Global e por Rúbrica

Relatório DPPC 2006

Same report produced by the customized DHIS as of 2006:

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
SERVIÇO NACIONAL DE SAÚDE

Direcção Provincial de Manica
Análise de Situação - Internamento
Período de Jan-06 a Dez-06

Anexo 18

Distrito	Nº de Camas	Total Dias Cama/Ocupada (DCO) Jan-Dez 2005	Jan-Dez 2006	% Evolução	DCO Mês Notif	Taxa de Ocupação de Camas	Total de Altas* 2006	Tempo Médio Internam	Rendim. Médio da Cama	Intervalo Rotação da Cama	Total de Fundos Gastos em Alimentação: Em Dinheiro	Em Géneros	TOTAL	Fundos Gast/DCO	OBS
CIDADE DE MAXIXE	170	0	101	0.00%		0,02%	130	0,78	0,76	38,45	45	45	90,00	0,89	
FUNHALOURO	170	0	184	0.00%		0,04%	354	0,52	2,08	13,89	12	12	24,00	0,13	
GOVURO	280	0	92	0.00%		0,01%	184	0,50	0,66	45,15	12	12	24,00	0,26	
HOMOINE	390	0	48	0.00%		0,00%	107	0,45	0,27	108,90	23	23	46,00	0,96	
INHARRIME	390	0	180	0.00%		0,02%	360	0,50	0,92	32,00	23	23	46,00	0,26	
INHASSORO	450	0	103	0.00%		0,01%	193	0,53	0,43	69,41	23	23	46,00	0,45	
JANGAMO	450	0	136	0.00%		0,01%	281	0,48	0,62	47,56	23	23	46,00	0,34	
MABOTE	400	0	92	0.00%		0,01%	184	0,50	0,46	64,72	23	23	46,00	0,50	
MASSINGA	115	0	48	0.00%		0,01%	96	0,50	0,83	35,44	23	23	46,00	0,96	
MORRUMBENE	445	0	32	0.00%		0,00%	67	0,48	0,15	198,78	23	23	46,00	1,44	
PANDA	445	0	79	0.00%		0,01%	136	0,58	0,31	97,58	23	23	46,00	0,58	
VILANCULOS	445	0	360	0.00%		0,03%	720	0,50	1,62	18,04	23	23	46,00	0,13	
ZAVALA	445	0	360	0.00%		0,03%	720	0,50	1,62	18,04	23	23	46,00	0,13	
TOTAL	4,595	0	1,815	0.00%		1,32%	3,532	0,51	0,77	38,52	299,00	299,00	598,00	0,33	

<< DCO Maternidade HC e HP incluem sala de Partos e Enfermaria de Obstetricia >>

Componentes do Grupo

Notas para a Discussão
(1) Qualidade dos Dados
(2) Diminuição Acentuada da Actividade
(3) Taxa de Ocupação
-Muito Baixa
- Muito Alta
(4) Fundos / DCO
-Muito Altas
- Muito Baixos

Desempenho dos Distritos		
Baixo	Medio	Alto

* Altas que incluem Obitos

Distritos Desfavorecidos

Possíveis Soluções

(1) Supervisão Dirigida
(2) Atribuição de Camas
(3) Revisão da Distrib. de Fundos
- Global e por Rúbrica

Relatório DPPC 2006
2007/04/1

APPENDIX H

Different computer systems in use in the Mozambican health sector

Name	Platform	Type	Purpose
Sisprog	MS-DOS	Database	Database Management of health data at National and Province levels
SIMP	MS-Windows	Spreadsheet	Integration of the various systems at the province and MISAU
BES	MS-DOS	Database	Weekly Disease Surveillance
Pharmacy	MS-Windows	Database	Management of drugs related data
SIP	MS-Windows	Database	base Human resources management at National and Province levels
SIM_Org	MS-Windows	Database	Management of maintenance related data
SIGETS	MS-Windows	Database	Management of logistics and stocks related data
SISAFE	MS-Windows	Database	Management of finance related data
HIV/SIDA	MS-Windows	Database	Management of HIV related data
D03, D04	MS-Windows	Spreadsheet	Management of infrastructure related data at Province level
Tuberculoses	MS-Windows	Spreadsheet	Management of TB related data
CDS/ISIS	MS-Windows	Database	Documentation Management
GIS data USAID	MS-Windows	Database	GIS data on infrastructure
Modulo Basico	MS-Windows	Database	System for SIS at district and province levels

APPENDIX I

Definitions and target groups for MCH and EPI health programs

Health Program	Definition
MCH	**Maternal and child health**
First antenatal visit	First visit by trained personnel during each pregnancy
Institutional deliveries	Deliveries assisted by trained personnel in health facilities
First post partum visit	First check-up visit done by trained personnel within less than 6 weeks after delivery
EPI	**Expanded Program on Immunization**
Polio 0	Oral polio vaccine before 6 weeks of age
BCG	Baccile Calmette Guerin vaccine in under 12 months of age
DPT+HepB 3	Third dose of Diphtheria, Pertussis, Tetanus and Hepatitis B vaccine in under 12 months of age
Measles	Measles vaccine in under 12 months of age

Target Group	Percentage of total Population
0 – 11 Months eligible for polio; measles; Diphtheria, Pertussis, Tetanus and Hepatitis B (DPT+HepB) vaccines	3.9%
0 – 11 Months eligible for Bacille Calmette Guerin (BCG) vaccine	4.0%
Expected pregnancies	5.0%
Expected institutional deliveries	4.5%
Post partum visit	4.5%
Women of child bearing age	24.9%